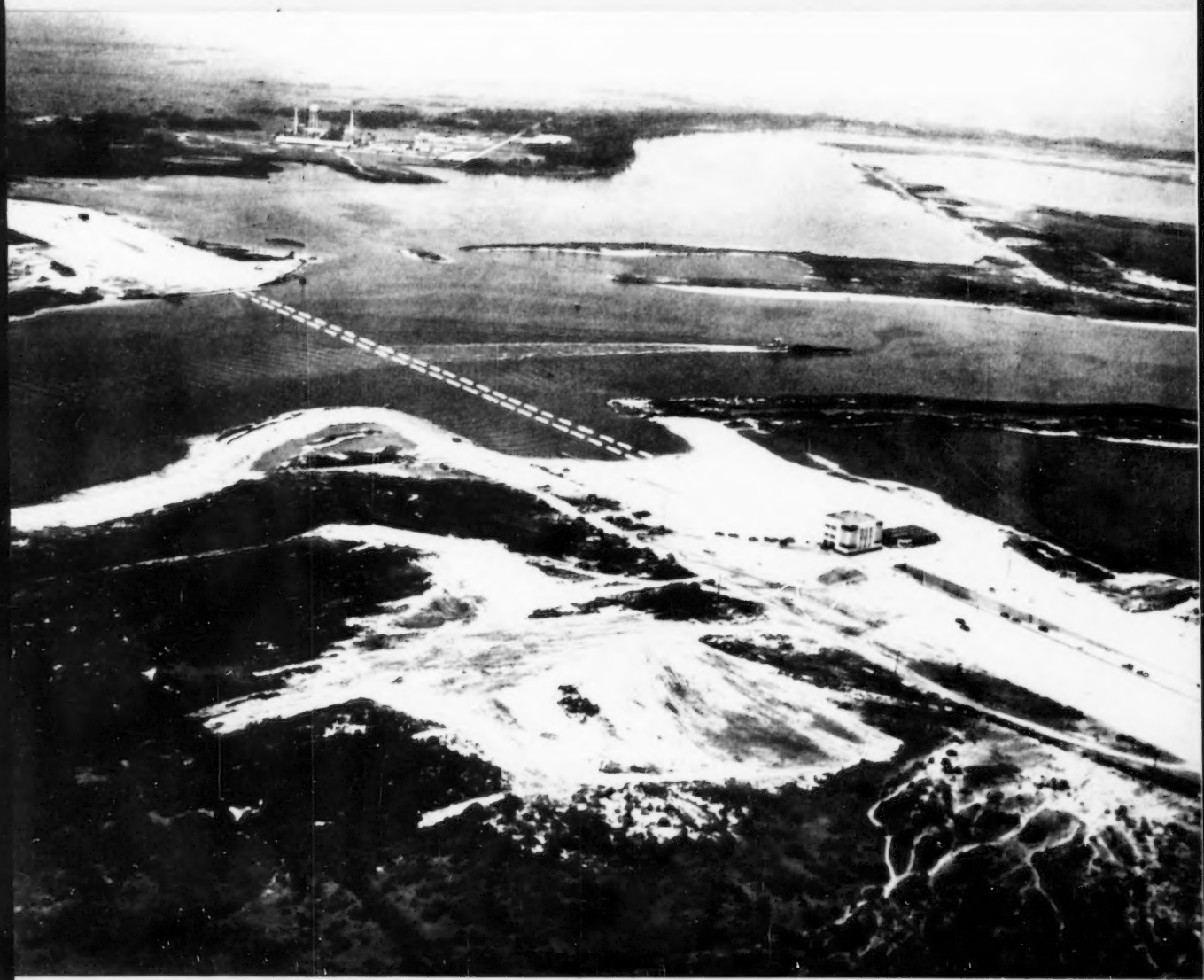
DECEMBER, 1953

Traffic Engineering



Houston Ship Channel Showing the Location of the New Baytown - La Porte Tunnel

- Economy of Freeways
- Urban Transportation Problems
- Parking and its Importance to the Downtown Business District
- Shopping Center

Official Publication of the Institute of Traffic Engineers

Amazing! Now you can handle every detail of a big highway striping project with the Model 345 Reflecto-Liner . . . all in one easy operation! This unique machine is engineered to answer the requirements of all large-volume reflective marking jobs . . . with maximum efficiency . . . at a tremendous saving of time and labor. No delays for re-loading. No extra trips to make. The Hi-Capacity Compressor and Dual Pressure Tanks assure smooth, uninterrupted performance.

The special *extra features* of this heavy Striper make it possible for *three men* to accomplish the work of five! The truck driver, who guides the striping operation . . . one man, sitting to the rear, applying the reflective marking material . . . and another, sitting beside him, distributing the zee-guards . . . that's all you need! It's all done so simply and economically . . . not in the usual two slow stages . . . but in *one, fast, money-saving operation!*

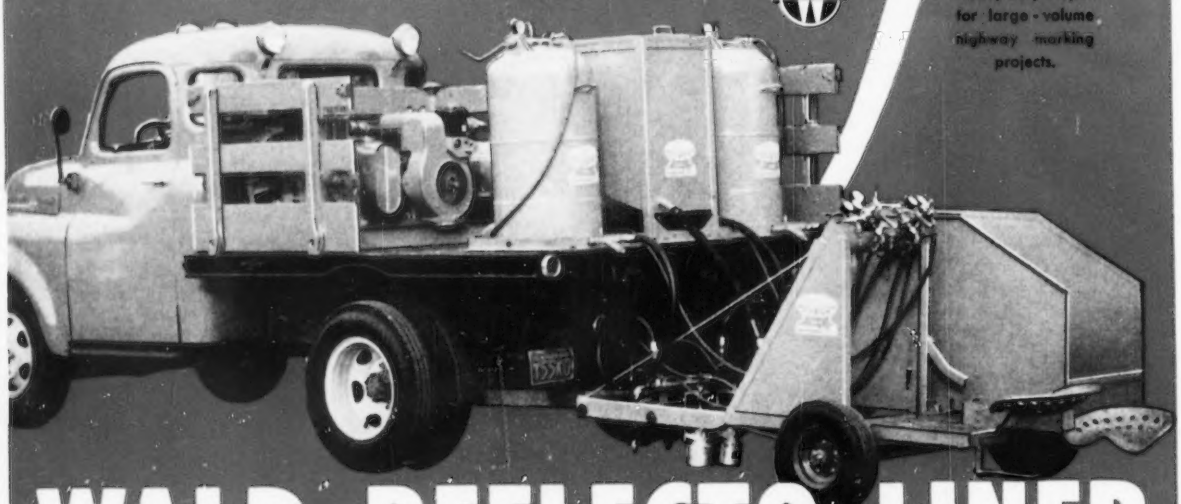
All in one operation!

Write, wire or phone for complete details . . . today!

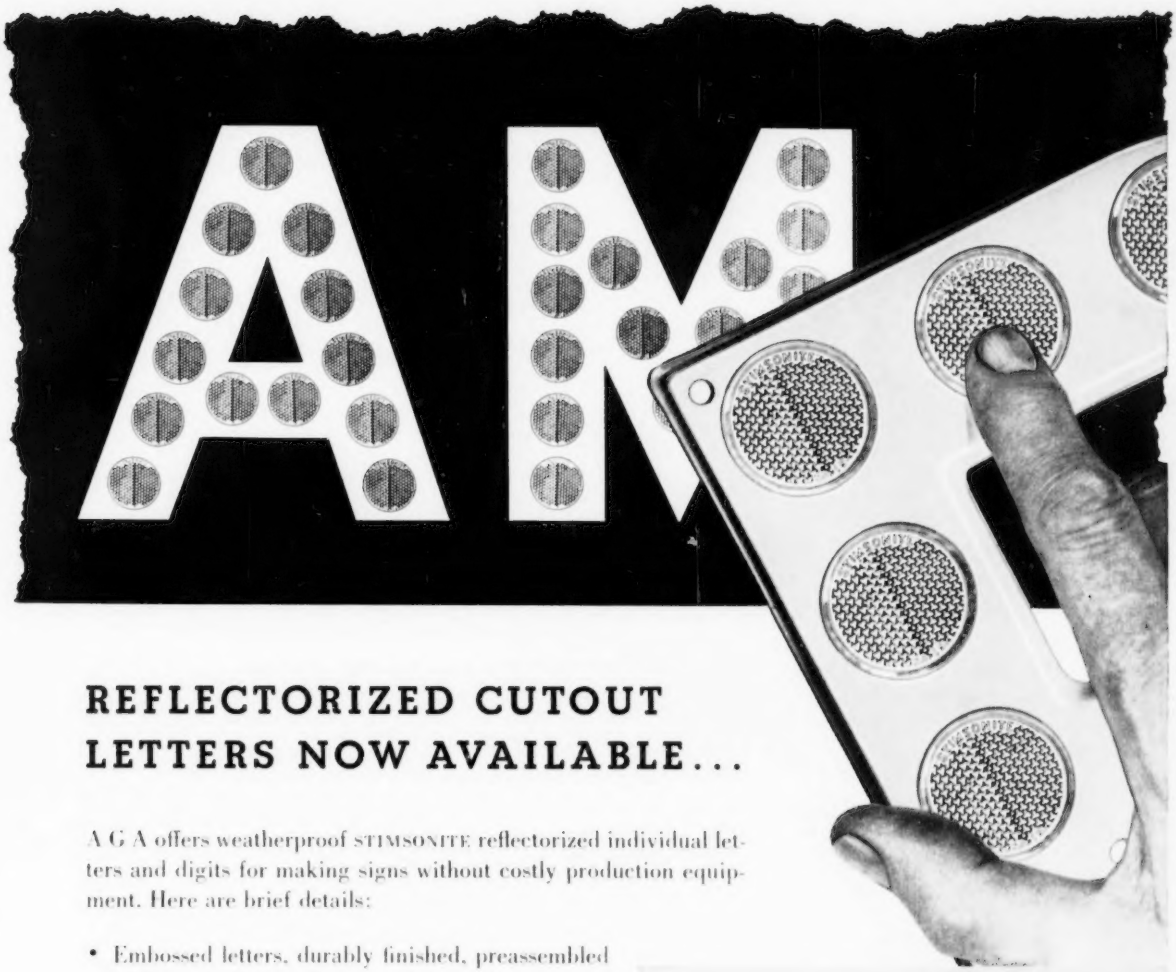
WALD INDUSTRIES, INC.
MONTGOMERY, PENNSYLVANIA

REFLECTO-LINER

MODEL 345
Heavy Duty Striper for large-volume highway marking projects.



WALD REFLECTO-LINER



REFLECTORIZED CUTOUT LETTERS NOW AVAILABLE...

A G A offers weatherproof STIMSONITE reflectorized individual letters and digits for making signs without costly production equipment. Here are brief details:

- Embossed letters, durably finished, preassembled with STIMSONITE reflectors
- Complete alphabets, with arrow accessories, ranging in letter height from 6" to 24"
- Designed for maximum day and night legibility

Consider these direct advantages of detachable copy:

1. **Change of message whenever necessary**
2. **Simple correction of spacing errors**
3. **Economical field repairs and maintenance**
4. **Reuse of copy for temporary signing**

Typical installation

WRITE for further information. We'll include spacing information and details on STIMSONITE's superior lifetime reflectorization.

STIMSONITE® *for* — *Seeability* / *Readability* / *Durability*

AGA DIVISION

ELASTIC STOP NUT CORPORATION OF AMERICA
1027 NEWARK AVENUE, ELIZABETH 3, NEW JERSEY

NOW CROUSE-HINDS

complete line of

NEON Signals

gives you **4** distinctive models

Type TNA-1
Arrow Neon Signal

Type TNO-1 One-Line Neon Signal

Type TNO-2
Two-Line Neon Signal

A Nationwide Distribution Through Electrical Distributors

Type TNO-3 Two-Line Neon Signal

Each does a special job better than any other signal.

The addition of two new signals, Types TNA-1 and TNO-3, increases the Crouse-Hinds family of neon signals to four different models . . . a complete line to meet your every need. Neon signals are ideal for the control of pedestrians and their large brilliant letters are perfect for route markers and information signs.

Type TNA-1 The big bright arrow is just what you have been waiting for. It can be seen farther, and maintains its shape at greater distances, that any conventional arrow. Drivers "read" the signal sooner and proceed with assurance. The result is greater safety and faster flow of traffic.

TNA-1 can be added to any conventional traffic signal.

The **TNO Series** is primarily for pedestrian control. Because of their distinctive shape and color, they command obedience, resulting in fewer pedestrian injuries.

Type TNO-1 is a one-line neon signal with up to ten 4½-inch high letters.

Type TNO-2 is a two-line signal with shorter lines. It is useful where width of sidewalk and pole location must be considered.

Type TNO-3 is the latest addition to the TNO Series and combines the advantages of TNO-1 and TNO-2 in a single unit. It not only has two lines but each line is full length . . . up to ten letters. It can handle jobs that are beyond the capacity of the other units. For example, you can have a full length DON'T WALK signal in *Red*, the danger color, on the upper line and also a WALK signal in *Green*, the safety color, on the lower line. The extra letters . . . up to twenty in all . . . make this unit more valuable for use as a warning or information sign.

All neon signals can be furnished with slip-fitter mountings or with brackets for pole mounting. They are available in two-way assemblies.

Crouse-Hinds neon signal housings are cast aluminum, rigid, light weight, and both dust-tight and weatherproof. They are built to Crouse-Hinds high standard of quality and will give years of dependable service.

Write for additional information.

CROUSE-HINDS COMPANY
Syracuse 1, N. Y.

OFFICES Birmingham — Boston — Buffalo — Chicago — Cincinnati — Cleveland — Dallas — Denver
Detroit — Houston — Indianapolis — Kansas City — Los Angles — Milwaukee — Minneapolis
New Orleans — New York — Philadelphia — Pittsburgh — Portland, Ore — San Francisco — Seattle
St. Louis — Tulsa — Washington. RESIDENT REPRESENTATIVES Albany — Atlanta
Baltimore — Charlotte — Corpus Christi — Richmond, Va. — Shreveport
Crouse-Hinds Company of Canada, Ltd., Toronto, Ont.

TRAFFIC SIGNALS · CONDULETS · FLOODLIGHTS · AIRPORT LIGHTING

Traffic Engineering

OFFICIAL PUBLICATION OF THE INSTITUTE OF TRAFFIC ENGINEERS

VOLUME XXIV | DECEMBER, 1953 | NUMBER 3

INSTITUTE OFFICERS

DONALD M. MCNEIL
President

HARRY W. PORTER, JR.
Vice-President

CHARLES W. PRISK
Vice-President

THEODORE M. MATSON
Secretary-Treasurer

•

PUBLICATION STAFF

M. MANSFIELD TODD
Editor

S. G. NOWELL, JR.
Business Manager

Associate Technical Editors
ROBERT S. HOLMES, EDMUND R. RICKER
MARTIN C. STARK

Associate Editors

H. A. BARNES — R. H. HARLESTON, JR.
H. M. BATTS, JR. — C. S. LECRAW, JR.
J. A. CARROTHERS — EUGENE MAIER
C. C. CLARK — S. T. SIEGEL
NORMAN KENNEDY

PRESS OF INTERSTATE
PLAINFIELD, N. J.

COVER: The new Baytown-La Porte multi-million dollar tunnel in Texas is 3,009 feet in length, portal to portal. The $10,000,000 plus tunnel took almost four years to complete and replaces the Morgan's Point Ferry at the same crossing, which was first opened in 1933. The ferry, which was operated by the Texas Highway Department, carried 18 cars per trip and was operated 16 hours a day. In speaking of the ribbon cutting ceremony, D. C. Greer, State Highway Engineer, said, "This event marks another milestone in our history, being the first and only tunnel in the Texas Highway system." See Traffic Products and News for further details.

Traffic Engineering is that phase of engineering which deals with the planning and geometric design of streets, highways, and abutting lands, and with traffic operation thereon, as their use is related to the safe, convenient, and economic transportation of persons and goods.

May We Offer . . .

The Economy of Freeways 83
Lamar W. Gardner

Urban Transportation Problems 87
Ralph F. Gross

24th Annual Meeting Paper
Parking and its Importance to the Downtown Business District 89
Henry K. Evans

Letter to The Editor 97

Shopping Center 98
T. R. Affik

Traffic Products and News 101

Buffalo Rears Its Ugly Head! 106

Section News 106

New Appointments 109

Looking Ahead 109

Position Available 109

Administration Report 110

Technical Division Activities 111

Index to Advertisers Inside Back Cover

Published Monthly by the

Institute of Traffic Engineers

PUBLICATION office:
Interstate Printing Corp.
400 Watchung Avenue
Plainfield, New Jersey

EDITORIAL AND ADVERTISING offices:
Strathcona Hall
New Haven 11, Connecticut

Entered as second-class matter November 7, 1941, at the Post Office at Plainfield, New Jersey, under Act of March 3, 1879. ¶Single copies 40 cents, subscription price $3.50 per year in the United States; $4.75 per year to foreign countries. Other publications of the **Institute of Traffic Engineers** include Annual Proceedings, Traffic Engineering Handbook and Technical Bulletins. ¶**The Institute is not responsible for any statements made or opinions expressed in its publications. Publication of advertising does not constitute Institute approval or endorsement of the products or services advertised.** Permission to reprint contents with customary credit line is given unless otherwise stated.

WHY TRAFFIC EXPERTS CHOOSE DUAL METERS

6 REASONS WHY DUALS stand the "gaff" and give better service longer!

1. **SETH THOMAS CLOCK MOVEMENT...** Backed by the world's most famous fine clock maker.
2. **STAINLESS STEEL COIN MECHANISM** . . . Smoother running in all weather conditions.
3. **WEATHERPROOF HEAD...** With handy work-shelf door.
4. **SUPERIOR DESIGN...** Discourages cruising; time indicator visible only from sidewalk side.
5. **ON-THE-STREET TIME-AND-COIN CONVERSION...** To meet changing traffic conditions.
6. ✓ **EASY TO PATROL AND OPERATE . . .** Observation window shows slug or tampering at a glance. No levers to move.

Single head and Dubl Dual meters have the same efficient automatic mechanisms—one in the single head; two independent mechanisms in the Dubl Dual.

✓...Duals are easier to operate and enforce

SIMPLICITY of operation and patrol are two important reasons why Dual Automatic *Gearshift* Parking Meters are popular with leading traffic engineers everywhere.

The motorist simply deposits a coin and Dual meters do the rest . . . no handles, levers or plungers to turn, pull or push. Shoppers especially appreciate this automatic feature.

Traffic departments in Dual cities have their own reasons for liking Dual meters. 1) Slugs or tampering can be detected at a glance. 2) Cruising is discouraged because the time dial is visible only on the sidewalk side. This feature alone builds revenue. 3) The bold red expired flag can be seen at a glance by the patrolling officer. 4) Dual meters are built to give longer, trouble-free service. 5) Time and coin changes can be made on the street as traffic conditions warrant.

Before you install any meter, weigh these Dual advantages. And learn about the specialized service available to every Dual-equipped city. Whether you choose the popular Dual single head or the new Dubl Dual . . . you'll get the precision built meter that's setting the pace in parking service and efficiency. Write today for Bulletin DU-521 for on-street parking; Bulletin DU-522 for off-street parking.

THE DUAL PARKING METER COMPANY

A subsidiary of The Union Metal Manufacturing Company

Canton 2, Ohio

Frankly Speaking

CONTINUALLY, we hear about traffic engineering accomplishments in our larger municipalities—installation of new traffic control equipment, construction of underground garages, completion of new expressways, improved protection for pedestrians, plans developed for freer movement of traffic and new techniques employed for providing adequate transportation facilities for new business developments.

True, there is a transportation problem in every large community in the United States, but far more serious is this problem in our municipalities under 50,000 population. The problem is more serious because the responsibility for traffic engineering is not being assumed by the municipal engineering departments in many municipalities of this population size.

Less than half of our cities under 50,000 population have indicated the traffic engineering responsibility in the city engineering department. About one-fourth say that non-engineering department heads do this work while about one-third have indicated that the police department is the traffic engineering unit of the community. There has been practically no increase among these communities in placing traffic engineering under municipal engineering department guidance during the past five years.

Police administrators are the first officials to tell you that traffic engineering is not a police function, yet they must do a "smattering" job if anything in this particular field is to be accomplished. Directors of police schools and academies say the same. These officials will tell you that absence of traffic engineering nullifies law enforcement.

Many top municipal officials of smaller communities have erroneously assigned the responsibility because of misunderstanding and the lack of knowledge of our profession—its scientific, factual and analytical approach to the traffic problems. Once they have a clear understanding of just what traffic engineering is, they become a good salesman for our profession.

A number of such municipalities have employed consultants to make surveys which outline requirements for improving traffic movement and control. Such arrangements have worked out with remarkable success.

In some states the Division of Highways has given assistance to smaller communities in finding solutions to their traffic problems. Yet, with these successful arrangements there still remains a low percentage of cities placing the responsibility in the municipal engineering department.

Therefore, what is the answer? Should the Institute of Traffic Engineers take the leadership in promoting the proper placement of traffic engineering responsibility in smaller communities? Should the Institute encourage more traffic engineering conferences and schools for municipal engineering officials? The problem is serious and we can be certain that if nothing is done, more non-engineering departments will be traffic engineering departments in these communities.

Harry Carter

Vice-President

I'M STANDING PAT WITH PRISMO

BECAUSE IT'S A WINNER EVERY TIME

Every day, more highway departments are swinging to the belief that it's not worth the gamble to put down inferior, untested reflective markings on their roads and streets. Stakes are high where human lives are involved and you have a feeling of confidence when Prismo is your ace-in-the-hole for safety. Prismo's pioneering and acknowledged leadership for fifteen years in the field of reflective marking makes it the one sure winner every time.

PRISMO HAS A FULL HOUSE OF FEATURES

Prismo's many exclusive advantages over ordinary traffic paint make it the natural choice of traffic engineers from coast to coast. *It will outwear ordinary paints many times, and its initial cost is low.* It's easy to apply and goes to work immediately with unmatched brilliance. "Moisture-Proof" striping and Prismo's other exclusive features are your assurance of greater safety and longer dependability.

"NOTHING EQUALS PRISMO... BUT PRISMO"

PRISMO SAFETY CORPORATION

HUNTINGDON, PENNSYLVANIA

The Economy of Freeways

By Lamar W. Gardner (Assoc. ITE)
Civil Engineer, Street & Parkway Design Division, City of Los Angeles, California

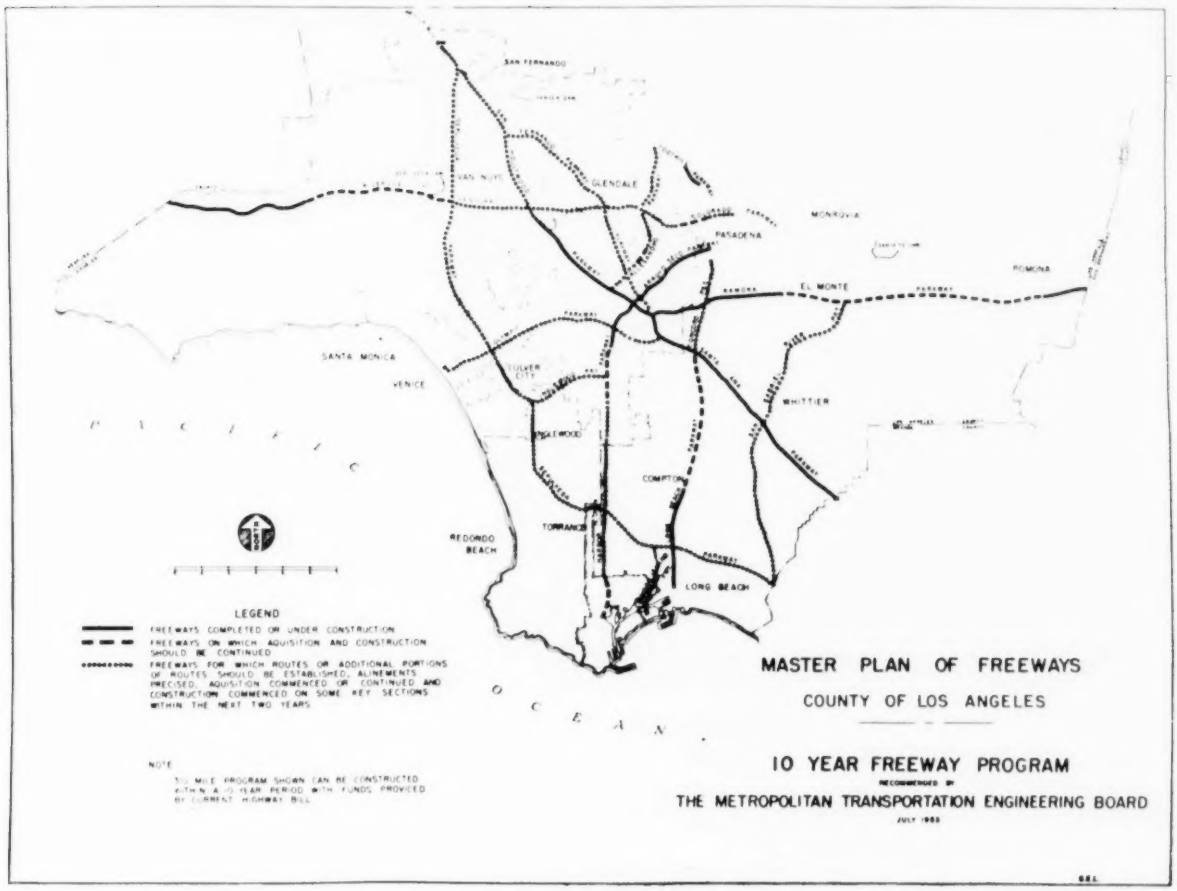


Fig. 1
Master Plan of Freeways

Los Angeles Freeways

IN THE Los Angeles metropolitan area lack of a rapid transit system and the great predominance of rubber tired transportation, coupled with a large and rapidly growing vehicle registration, make the subject of freeways almost as interesting to the average citizen as would be the matter of a life preserver to a drowning man. It is worthy of note that only six States in the Union have a larger vehicle registration than Los Angeles County. Many differ concerning our freeway program, stating that rather than a life preserver it will become a millstone around our necks. Notwithstanding, the 70 miles of freeways constructed receive a very heavy and increasing use, attesting to their popularity with the motorist taxpayer.

The Hollywood Freeway, now partially completed, carries 125,000 vehicles daily over its 8 traffic lanes. Next year, when the connecting link to Cahuenga Pass is finished, it will be a continuous freeway passing through the northerly end of the Central Business District and thence westerly through Hollywood and some of the most densely populated area of the region. This freeway will be a direct continuation of heavily traveled main transcontinental and State Highway routes. The State Division of Highways estimates that 135,000 vehicles daily will travel over the most heavily used section. Added to this will be its share of a predicted 100% increase in Statewide motor vehicle registration in the next 20 years. This estimate of growth is claimed to be on the conservative side as measured by available growth factors. Therefore it is indicated that in a very few years traffic engineers will have the opportunity of observing peak hour flow under ultimate capacity limitations on this freeway unless other parts of the proposed system are constructed as a relief.

The Arroyo Seco Freeway also carries more than 100,000 vehicles daily, with an appreciable annual increase. Ultimate capacity flow is also indicated on this freeway if relief is not provided.

In addition to the 70 miles of freeways already constructed, it has been recommended by the Los Angeles Metropolitan Transportation Engineering Board that 240 miles additional be approved by the governmental units within the metropolitan area for construction by the State Division of Highways within the next 10 years. See Figure 1. State Highway funds were increased this year when the State Legislature raised the State gas tax from 4½c per gallon to 6c per gallon, with corresponding rises in other motor vehicle taxes. Freeways in the State Highway System, whether rural or urban, are financed entirely from State Highway funds, and it is the opinion of the Metropolitan Board that the additional 240 miles can be financed entirely from the augmented highway funds.

Express Buses

Express buses, either metropolitan or longer distance, now use all the freeways. Intense efforts are being made to achieve a comprehensive metropolitan express bus system in the face of many difficulties. Bus stations on freeways at transfer points within the City of Los Angeles are financed by the City, as it has been ruled that State gas tax revenues cannot legally be used for this purpose. See Figure 2. Recovery of this investment is made through franchise taxes.

Fig. 2
Bus Ramps on Hollywood Parkway

Trucks

Trucks now use all freeways excepting the Arroyo Seco Freeway as they cannot be barred from State Highways unless an alternate route exists or is provided. Two recent accidents involving trucks touched off a Councilmanic investigation of the operation of both trucks and buses on the freeways within the City of Los Angeles. One of these accidents produced four fatalities and the other occurred in an underpass where a gasoline semi-trailer-truck involved in the collision was in great danger of catching fire from a burning vehicle. Operation of trucks on freeways will probably be finally resolved on a Statewide basis, and the urban problem may resolve itself into a proposal for providing special routes when the magnitude of the truck problem justifies it. The accident rate for buses does not seem to indicate any special problem insofar as the relative safety of buses is concerned.

Criticism of Freeways

This tremendous freeway program has not arrived at its present status without much controversy, some of it being factual but far too much being a matter of opinionated heat. Consequently it became necessary that the City Engineer, Mr. Lloyd Aldrich, have his staff make sufficient studies to furnish facts to those interested as to the operation and economy of freeways. In March 1952 TRAFFIC ENGINEERING carried my article on the subject of Capacity, Time Savings and Safety of Freeways in this area. Reports on freeway accidents from the Police Department of the City of Los Angeles, radar measurements of speeds of over 10,000 vehicles on the Arroyo Seco Freeway by the Traffic Engineer, speed and delay runs on surface streets in the City by the Bureau of Engineering, when assembled into an engineering study, warranted the conclusion that "a freeway on an equal number of lanes basis handles three times the number of cars at twice the average speed and at an accident rate five times as favorable as a comparable surface artery."

Subsequent sharp criticism of the high cost of freeways averaging five or six million dollars per mile through the densely built up urban areas indicated the need for a study of the economic benefits to the motorist taxpayer in addition to other general benefits not as susceptible to monetary evaluation. With the above background to show the origin of the study in this area, we may now proceed with the main theme of this article.

Benefits to Motorists

Direct benefits to the motorist when traveling on a freeway as compared to a typical surface artery can be evaluated in monetary terms which are tangible and demonstrable. In order to arrive at a conservative yardstick of savings to the motorist which may be applied to the economic comparison between surface streets and urban freeways, it is necessary to establish a low minimum average which is universally applicable within a given area. All motorists are well aware of the varying conditions encountered in driving in one direction for a trip of several miles through a city. In the Central Business District of Los Angeles signals are encountered at every intersection, heavy pedestrian concentrations exist, overall speeds drop to below 10 miles per hour, and maximum cost of automobile operation occurs. Conditions are somewhat better in other than solidly developed business areas, yet enough stops and congestion still occur to make surface stop and go driving quite costly as compared to non-stop freeway driving.

Recent speed and delay studies show that the average overall speed over a distance of 30 miles between El Monte and Santa Monica, using the best surface route, is less than 25 miles per hour. The same is true between Pasadena and Imperial Highway, a distance of 20 miles, on a route via Figueroa Street to San Pedro. Many other shorter runs confirm this figure. Therefore the yardstick used in this analysis, called "Minimum Benefits to the Average Motorist" will apply in the more congested traffic area extending roughly from Imperial Highway on the south to the Santa Monica Mountains-Griffith Park on the north, and from Rosemead-Lakewood Boulevard on the east to the Pacific Ocean on the west. This would also apply to the more densely built up areas of San Fernando Valley and the area tributary to the Arroyo Seco Freeway. In other less congested areas of the City the benefits would be more variable and would offer

less opportunity for formulating a benefits floor. Minimum benefits within the area outlined are given as follows:

Minimum Benefits to Motorists Using Freeways

Average Savings Per Vehicle Mile	
(1) Gasoline Savings	0.33c
(2) Maintenance Cost Savings due to elimination of stop and go travel	0.24c
(3) Accident Savings	0.56c
(4) Time Savings (commercial vehicles only)	0.87c
TOTAL	2.00c

Detailed Analysis of Minimum Benefits to the Motorist

(1) *Gasoline Savings*

Stops in traffic sharply increase gasoline consumption. Speed and gas consumption studies made by the Automobile Club of Southern California in 1942 and 1947 with a car specially equipped for measuring gas consumption found that there was a variation of from 8.70 miles per gallon on congested downtown streets to 23.867 miles per gallon at 25 mph without stops. It is assumed that the decrease in miles per gallon is directly proportional to the number of stops. It is also a well-known fact that gasoline consumption increases in almost direct proportion to the increase in speed between 20 mph and 70 mph. The results obtained by the Automobile Club illustrate the two variables in the following table:

Gasoline Consumption and Fuel Costs Per Mile

Speed	Miles per gal. (No stops)	Fuel cost per mile, cents (No stops)	Miles per gal. (5 stops) (per mi.)	Fuel cost per mile, cents (5 stops)
25 mph	23.867	1.17	15.748	1.78
30 mph	22.750	1.23	13.600	2.06
45 mph	20.000	1.40	9.685	2.89

Note: Above costs are based on a fuel cost of 28c per gallon.

In speed and delay studies on surface streets in Los Angeles it was found that progression through signals was best when attempts were made to maintain a speed of 30 mph. Due to being occasionally delayed by a turning vehicle or an unsynchronized signal so that the test vehicle was stopped at a signal, the overall speed was less than 25 mph. The speed referred to in the table, however is the 30 mph speed maintained between signals. On the second line of the table, at 30 mph, with 5 stops per mile, the fuel cost per mile would be 2.06c. On the third line of the table, at 45 mph, without stops, which is average speed for a freeway, the fuel cost would be 1.40c. The cost per stop, then, for a comparison between freeway and average surface driving, would be 2.06c — 1.40c = 0.66c ÷ by 5 = 0.13c per stop.

In speed and delay studies on many of the major boulevards, such as Figueroa Street, Olympic Boulevard, Wilshire Boulevard, Beverly Boulevard, Riverside Drive, and Ventura Boulevard, it was found that on routes parallel with those freeways listed in the first priority program there was an average of two stops per mile for daylight operation. This small number of stops per mile was surprising. Undoubtedly this is the result of the excellent work done by the Traffic Engineer in bettering progression through signals in the entire area. Driving through progressively timed signals at an overall speed of less than 25 mph is accompanied by a certain variation in sustained speed, which also causes increased gas consumption. Therefore ½ a stop per mile is added to cover this, resulting in a total of 2½ stops per mile, or an increased cost of 0.33c per mile. This is less than has been estimated previously. No doubt earlier estimates were weighted too heavily with the acute delays through bottlenecks where traffic sometimes waits several cycles of signal change before getting through, such as the signal at Vignes and Aliso Streets. Here the backup extends so far that cars are sometimes held up for as many as ten cycles during the peak hours. Such delays caused by dense traffic in busines areas are much more remembered than the conditions experienced in the other areas. However, the above estimate is based on an actual count of stops per mile over long enough distances to represent freeway operation.

(2) *Savings in tires, brakes, oil, and general maintenance due to elimination of stop and go travel.*

Although very little information is available concerning the amount of maintenance costs due to stops, it is certain that practically all the required maintenance of brakes and clutch can be attributed to stops. Consultation with repair garages in the Los Angeles metropolitan area finds that the average car requires a minimum of brake relining and adjusting of $25 per 25,000 miles when driven under average urban conditions. Also the clutch for the average car requires a minimum expenditure of $35 per 35,000 miles. The cost for both these items sums up to 0.20c per vehicle mile. Non-stop travel on the freeways would eliminate at least 90% of this cost, or 0.18c per vehicle mile.

Viewing the items of which only a portion is caused by stops, tires will cost a minimum of $80 for 30,000 miles, or 0.27c per mile driven. Cost of moving parts repair, exclusive of clutch or brake, will, according to surveys of fleet operations where costs are much less than private car operation, average 0.25c per mile. Assuming that 1/8 the costs of the last two items is caused by stops, there is found 0.06c to add to the 0.18c representing brake and clutch costs. The total extra cost per mile occasioned by stops then amounts to 0.24c per mile. This is less than the amount estimated by other engineering analysis. However, in order to arrive at figures beyond challenge, minimum figures are used, even though they may seem absurbly low to some.

(3) *Accident Savings.*

The Insurance Commissioner for the State of California reports that direct premiums written for automobile insurance in the State for 1950 amounted to the following:

Automobile physical damage	$127,592,833
Automobile property damage	$ 56,208,703
Public liability	$ 99,997,840
TOTAL	$283,799,376
If we subtract dividends to policy holders of	$ 8,624,925
we have a *TOTAL* of	$275,174,451
Records in the Commissioner's office indicate that approximately 25% of the automobile physical damage is for fire and theft and comprehensive coverage other than collision damage, amounting to	–$ 31,868,208
Subtracting this, there remains a *TOTAL* of	$243,306,243

According to advices received from the Association of Casualty and Surety Companies, based on monthly reports received from the Insurance Commissioner of California,

77.6% of the automobile registration is covered by the insurance premiums cited above. Expanding the amount to 100% of coverage by assuming that the remaining motorists carry their own accident costs, the annual cost of automobile accident coverage in California is $326,000,000. Based on reported gasoline consumption in California for 1950, and assuming an average of 15 miles travel per gallon, the total vehicle miles traveled in the State for that year approximate 46.4 billion miles.

Using the total cost of accident coverage cited above, divided by the total vehicle miles traveled, the accident cost per vehicle mile would average 0.70c. As brought out in a previous report on accident rates on completed sections of freeways, travel on freeways is made at one-fifth the accident risk that prevails on typical surface routes. With four-fifths of the accidents removed, the savings would be 4/5 x 0.70c = 0.56c per mile for freeway travel. It is worthy of note that the amount that is paid for protection against highway accidents far exceeds that paid in gasoline taxes for highway construction and maintenance. It should be noted further that the amount paid for automobile physical damage does not include the deductible amounts, which are usually in collision damage policies, the ordinary amount deductible being $50. Also there are large amounts of damage due to negligence, the loss of time at work, and the use of the car, which are not ordinarily collectible under insurance policies.

(4) Time Savings.

The value of time in commercial operations can be definitely determined. On the other hand, the value of time to the motorist driving to and from work, recreation, shopping, etc., is quite indefinitely determined. It has been ascertained in the eastern United States, where a motorist has a choice between free highway and toll facilities, that he is willing to pay 2c per minute of time savings, this being proven in the amount of his toll payments. According to the Highway Research Board "Abstracts" the average value of truck time is 5c per minute. Local investigations check this quite closely. Commercial registration of trucks alone amounted to 10.8% of the total State motor vehicle registration in 1951. Obviously many automobiles are used for business purposes which are not registered commercially. Assuming that 13% of the total traffic on freeways is commercial, whose time is valued at 5c per minute ($3.00 per hour) and that the time of the private car is worth nothing, then the average value of time for all traffic is 0.65c per minute. Since it takes twice as long for a surface trip as for the same trip on a freeway at 45 mph, 1 1/3 minutes of time per mile is saved by freeway travel, or an average saving for all traffic of 0.87c based on 13% of the traffic being commercial. It seems rational that at least 15% of the travel on a freeway is commercial.

If one wishes to assign a value to the time of a non-commercial driver, based on his proven willingness to pay tolls, then the average value of time for each vehicle using the freeway is raised accordingly. A study in New York found the value of time to the private vehicle operator to be $1.10 per hour (1.83c per minute) based on his willingness to pay tolls even though he had an alternate free roadway. Again assuming that 13% of the drivers are using their vehicles for commercial purposes, and using the above value for the time of the private car operator, the average value of time for all vehicles would be 2.24c per minute. For each mile driven on a freeway the average time savings would be 1.33 x 2.24c = 3.0c per mile. However, in order to arrive at a figure that could in no way be controversial, this report uses the figure of 0.88c per mile, which is all for savings to the commercial vehicles.

Additional Benefits to the Motorist and Citizen

In addition to the basic figure of 2c per mile of freeway operation savings, there are of course many other direct and indirect benefits to the motorist and general citizenry which cannot be easily evaluated in monetary terms, though none the less real. Among these are stabilization or enhancement of property values, relief of existing overburdened surface arteries, doubling of the practical radius of real estate development on a travel time basis, increased access to recreational or cultural facilities, increased mobility in times of disaster emergencies, increased tourist travel, reduction of strain of driving, and all of the other well known advantages in betterment of transportation. The benefits to the large amounts of traffic continuing to use formerly heavily congested arteries after the freeway system is built are not usually visualized. Before and after surveys have shown that removal of through traffic from surface arteries to the freeways benefits community business, property values, surface travel time, and safety on the surface system. In addition, the intended use of the freeways by express buses will greatly increase the economic value of the freeways to the general public, of which the motorist comprises a large part. The monetary value of these benefits could very well amount to huge sums, since they are all so vitally integrated with the general financial health and progress of the region. It should be borne in mind that conversely to the benefits accruing from having good transportation, if there were no freeways there would be the losses that the region would suffer without having them. Furthermore, the region has rapidly developed and is continuing to do so through the use, in the main, of the motor vehicle.

Application of Savings on Freeways Already Completed

Applying the above listed benefits to the record of vehicle mileage on presently completed sections of freeways, we find that, on the very conservative basis used herein, in the three year period 776,100,000 vehicle miles of travel at 2c per mile savings resulted in a savings of $15,522,000. The original cost of the 16.57 miles of freeways under study was $42,026,683. If the savings at the above rate could be applied to payment for the freeways, their original cost would be amortized in less than ten years. If the benefits over the remaining life of the projects, amounting to at least 20 years, are capitalized, the 16.57 miles of freeways would be worth over $100,000,000 to the motorist after the cost is recovered in benefits. In addition to these remarkable direct benefits to the motorist, we have also the unevaluated benefits to the region, which are of vast importance.

High Volume Versus Low Volume Freeways

The method of analysis outlined in this report makes possible an economic comparison between high volume freeways through intensely developed areas where land and construction costs are high, and outlying low volume freeways costing much less per mile. Factual economic analysis shows that due to the much higher benefits and volumes, the higher cost freeway will show a much greater return per dollar invested than outlying freeways which cost less but carry much lower volumes, with lower unit benefits to the motorist.

(Continued on page 96)

Urban Transportation Problems

By Ralph F. Gross (Mem., ITE)
Transit and Traffic Engineer, City of Chicago, Illinois

Mr. Gross's article has been prepared from a speech made by him at the Fifth Annual Traffic Engineering Conference, University of Illinois, December 12th, 1952. The views as presented in this article are those of the author and not those of the City Council of Chicago. —EDITOR

WHO CAN DENY that in the past several years, the problems of urban transportation have become increasingly important for the consideration and analysis of the traffic engineer? Yes, we in the traffic and transit engineering fields have finally realized that the problems of traffic and transit are inter-related. The very problems that face us stem from such basic causes as sociological, economic and psychological.

It would be an over-simplification of the statement to say that in local transportation we are faced with three primary problems and once we discover what is causing these problems we may then be able to seek a solution to them. The three basic problems are: (1) Why has automobile ownership and use increased at the tremendous rate it has, and how much longer will this increase continue? (2) How much are we to spend on our highway systems and our urban transportation systems? (3) How can we make urban transportation systems once more acceptable to the user?

Let us examine the cost of automobile ownership in terms of what it is costing the public to drive an automobile. The most recent data available indicates that the motorist with a medium-priced car, who drives approximately 12,000 miles a year and uses his car to and from his place of employment, is spending on an average of 14c per car mile. This 14c per car mile figure is based upon such factors as depreciation, insurance, vehicular city and state licenses, oil, grease, repairs and parking. In 1950, the same figure was only 10c per car mile. Unfortunately, the motoring public is not fully aware of the actual cost in operating the vehicle per car mile. The only thing the motorist is aware of is the actual "out of pocket" cost (gas and oil) which is two cents per mile. On the other hand, the average cost per mile on CTA lines in Chicago for the entire riding public is 5-6 cents per mile and on the motor and rail carriers is about 5 cents per mile. Therefore, car ownership is less economical than the use of local transportation systems. Other obvious factors are conducive to automobile ownership such as convenience in the nature of house to house service, an extremely important factor, and conspicuous consumption. Another term for conspicuous consumption is "keeping up with the Joneses." A third factor is the general decentralization that is taking place both in industry, commerce and housing. This causes the local transportation system to extend its lines into sparsely inhabited areas. As perimeters of urban areas expand, the areas increase in proportion to the square of the radius. For example, if the perimeter of an urban area is extended from five to ten miles from the center of the city, the area increases 250% whereas these newly settled areas may contain only 20-25% of the concentration of population as compared with the inner part of the urban area. Therefore, it becomes extremely difficult for mass transit systems to offer the usual service at the usual cost. Therefore, the principal cause of the large increase in automobile ownership, I believe, is primarily economics. The economics involved are or can be attributed to the greater propensity of the public to consume. In 1929, we find that of the total personal consumption expenditures of the American public for automobiles and parts amounted to 4%; in 1939, at which time we were in a recessive economy period, only 3.1% was spent and in 1950, 6.4% was spent.

How much can we afford to spend on our highway systems? How much can we afford to spend on our mass transportation systems? The time has come for engineers to look beyond the field of highway construction, highway design, etc., and try to obtain a picture of the overall services which the public needs and then weigh the relative needs and the good derived from these needs against the available funds. We engineers have been too narrow in our thinking; we have in the past concerned ourselves primarily with highway construction and highway needs; we have taken statistical data and used it as an argument for bigger and better roads. Most of the arguments were justified from the highway picture alone but the question is and will be in the future—Will the highway expenditure program fit into our general economic pattern? We must weigh the expenditures for highway facilities against expenditures needed to conserve our natural resources such as agriculture and power. We must also consider the expenditures needed for social security, programs which include health, education, pensions, job insurance, etc. We must consider the expenditures needed for defense and at the present time this takes top priority. Another important factor in our expenditure program is that of personal expenditures. A certain percentage of every dollar earned by the public goes for federal, state and local taxes. At the present time this amounts to 26%. For every dollar the "public" earns, 26c goes to pay bills of highway construction, social security, defense, etc., with 74c remaining for personal consumption. Of this 74c, 3c is now being spent for the purchase of automobiles and automobile parts, which leaves 71c for food, clothing, shelter, etc. Some of you no doubt know that at the present time we are spending 55 billion dollars a year for defense, and that it could be put to very good use in building highways. In all probability it could, but let us not forget the relative importance of the other services that are offered by the various governmental agencies which may need the money more than the highway program. One particular problem that appears is that of the State institutions for the sick, both in mind and body. This field all over the country is tremendously over-crowded and recent estimates indicate that it will require 30-40 billion dollars of facilities to adequately handle their patient load. Yes, there are many areas of expenditures for which we need money.

This leads to the question of how much do we need for mass transportation? At the present time the total investment in all local transportation systems amounts to 4 billion dollars. Estimates as to the total cost of correcting the existing deficiencies in our highway system and the cost of correcting additional deficiencies to occur in the next ten years total

55 billion dollars. Let us look at it from another side of the picture. In 1950, 4.3 billion dollars were spent on construction improvements and maintenance of the highway and street system. The above figures are simply the cost of correcting deficiencies and the cost of maintaining these systems and not the original total investment in our highway plant. Therefore, you can readily see that the 4 billion dollar investment in local transportation systems is relatively small compared with our highway systems. On the other hand, our local transportation systems carry 60-66 per cent of the total number of persons going to and from work each day in Chicago. If we were to replace our total local transportation investment with more modern and more efficient systems, the total cost would not be more than our present highway bill for one year and bear in mind that local transportation systems have a depreciation rate, on the average, of 15 to 20 years.

Finally, there is the 3rd question, which is probably the most important area to consider: How can urban transportation systems once more become acceptable to the user? The reason why local transportation systems are no longer acceptable to the user is due to the continuing decline in the number of revenue passengers which has occurred since 1946. Recent figures indicate that for the country as a whole there has been a drop in the passenger load of 30%. Therefore, we must do something with our local transportation systems to attract more passengers. The question of what to do is the concern of the entire industry.

Unsuitable mass transportation introduces or forces the use of private automobiles and when it does, it obstructs general vehicular movement and often causes complete tie-ups during rush hours, especially in the downtown areas. How can this extremely serious condition be alleviated? Our answer is to get the large number of private automobiles off the streets and supply instead attractive, convenient mass transportation. While the automobile carries on the average 2 persons per car, a large bus with a seat for everybody can carry from 46 to 56 passengers or, without too uncomfortable a load, can bring 70 to 80 passengers to and from the central business district. One bus can replace 25 to 35 automobiles. As automobiles are replaced by mass transportation riding, traffic congestion will correspondingly subside. First, the number of vehicles crowding the streets will be reduced. Second, the modern buses give freedom and elasticity of movement; they can bypass other traffic and they can be bypassed without stalling the vehicular flow in the streets. Under such conditions the remaining traffic will be much more manageable by the city but the big trick is to get the users of automobiles to shift to mass transportation. How can that be accomplished?

First you must examine the question of fares. What effect does the level of fares have on the extent of usage? In Chicago, the increase in fares since 1939 has kept pace with the increase in the general inflation of the cost of living. In other words, in 1939 Chicago had a basic 7c fare on the surface; in 1952 the surface fare is 17c on a token basis. However, the average working man has to work the same amount of time in 1952 as he did in 1939 to pay for his fare to work. There have been many statistical studies made to indicate the effect of the price on ride consumption usage. However, the cost or price of other commodities has risen proportionately to the increase in the cost of riding but the consumption has not fallen off to the same extent as riding.

At the present time the average local transportation fares in 51 cities is 14c. Chicago, Detroit and Kansas City have a straight 20c fare. New York City with its 10c fare and a deficit of $54,000,000 would have to have a fare of approximately 20 cents per ride to operate in the black. From an analysis of operating statements of mass transportation companies it appears that if the present rate of decline in its passenger loads continues for one and one-half years to two years, another round of fare increases will be likely.

The only thing that can prevent an increase in fare from coming about is by encouraging more users of our transportation systems. Even if we have a subsidy for our transportation systems we will still be paying for our rides either partly by indirect methods or partly by direct methods.

The major factor in fares is the cost of labor. Labor costs comprise more than 66% of the total cost of service to the riding public. Unfortunately, mass transportation is used primarily during two rush periods of the day. Each rush period is about 2½ hours. The agreements require the transportation companies to guarantee a full 8-hour day—an 8-hour day where the user demand is for a 5-hour service. If these problems can be satisfactorily worked out to meet the peak period requirements of the day, the cost of the transportation ride could be reduced.

Another factor to consider in making transportation systems more acceptable to the user is to provide a modernized transportation system, a system which provides faster and more convenient service to the user. During the period from the turn of the century to the present time very little change has taken place in the physical structure of the vehicles. The big change which is commonly called today a modernization program has occurred from a fixed rail operation to a rubber tire operation. The current vehicles have the same physical characteristics that were prevalent in the design of the old vehicles. The change in all vehicles has been primarily of the mechanical kind. The design has been single-deck vehicles, entrances approximately at either end of the vehicle, collection of fares on the vehicles, and stops occurring at 600 to 700 feet apart.

It is quite evident, then, that the modernization program which has taken place in many cities has had very little effect on attracting new users. From 1947 to the present time the C.T.A. has expended approximately $64,000,000 on new vehicles, switching from a 2-man rail operation to a 1-man rubber tire vehicle. However, in this modernization program two factors are apparent. One is that the vehicles have slower running time; and two, vehicles have a smaller carrying capacity. The old 2-man Pullman type cars formerly used by the C.T.A. carried a maximum capacity load of 155. The present rubber tire vehicle carries an average capacity load of 85. This is a reduction of 40% in the carrying capacity. On the other hand, the running time on a given line using rubber tired vehicles has been increased as much as 25%. This increase in running time can be attributed to the ever-increasing traffic congestion and to the time it takes to load and unload passengers.

Can this be considered a modernization program? The vehicles are new, the vehicles are shiny, and their seats are softer, but the vehicles do not offer better service to the riding public. These rubber tired vehicles, however, do offer greater maneuverability and allow vehicular movement of traffic to flow around them. The modernization program, as

(Continued on page 96)

24th Annual ITE Meeting Paper

No. 5. Presented at the Second Technical Session which was devoted to the subject, Planning, Wednesday morning, September 30, 1953.

Parking and its Importance to the Downtown Business District

By Henry K. Evans (Mem., ITE)
Highway Transportation Specialist,
Chamber of Commerce of the United States,
Washington, D. C.

THE PARKING PROBLEM in the downtown areas of our larger cities will never be solved. I make this prediction because I believe that it is uneconomical to meet all existing and potential parking demand in the high land cost cores of cities. Assuming that the forces of private enterprise continue to function, we will never arrive at the point of plenty of convenient parking for all comers.

Let me illustrate this point with several examples. Woodward and Lothrop have a fine department store in the heart of Washington, D. C. There is a parking problem in the District as there always has and as there probably always will be, so some of Woody's customers travel by public transit or walk who otherwise would probably use their automobiles. But consider this same store's suburban branch in Chevy Chase, Maryland, just outside the District of Columbia. Here the customer never worries about parking. Practically all customers arrive via private vehicle and there is ample space for everyone, year around, on the spacious parking lot adjoining the store. Woody's has solved its customer parking problem at the Chevy Chase store by providing three and a half times as much area for customer parking as is provided in the store itself. But obviously they can't do this at their downtown store. The reason, of course, is the difference in land cost. They paid less than a dollar per square foot in Chevy Chase—it would cost $15.00 per square foot, or more, to acquire land adjacent to their downtown store.

Recently I spoke before a group of downtown businessmen in Boise, Idaho, and I figured out for them roughly what it would cost to increase their parking capacity to shopping center standards. Boise's off-street space would have to be expanded thirteen-fold at a cost of about $33 million. Then there would be plenty of parking at all times, perhaps even during most of the Christmas shopping season. But who would put up this amount of money—more than what the entire business district is worth? I don't think anyone will put up money like that when a much smaller investment in suburban shopping centers in outlying areas will attract the same amount of business. It just isn't economical in my opinion, to make a parker's paradise out of existing city central business districts.

Expanding Cities

Since the war we have witnessed an astounding growth in numbers of suburban shopping centers, most of them representing substantial investments, too, on the order of a half to a million dollars. Twenty-five have blossomed out in Philadelphia alone, 31 in Minneapolis, and over 100 have sprouted up along the West Coast between San Francisco and Salinas, California. Many of these are gigantic projects—almost new cities in themselves. Northgate, outside Seattle, provides 5,000 parking stalls and Northland, near Detroit, provides 7,552 spaces. "Bay-Fair," to be located near Oakland, California, will cover 48 acres with 100 stores and offer 12,000 car spaces for free parking. A center near Cleveland, to be called the Meadowbrook Regional Center, will require 80 acres for 80 shops and two department stores, with 8,000 parking spaces. These capacities are no less than what we find in entire central business districts of big cities today.

Recognizing the practical economic impossibility of bringing the mountain to Mohammed, many department stores are establishing branch stores in outlying areas to reach customers who, otherwise, might never come to the downtown stores. According to John Guernsey, writing in the "Department Store Economist," suburban branches have grown more than ten-fold since 1940. The reasons are not difficult to assess. For instance, land and rent are cheaper, delivery service costs are usually less (in fact only about a fourth as many customers want home delivery from the branch as compared to the downtown store) and taxes, advertising, and payroll are frequently less.

This growth of suburban business centers represents an expansion of cities and it is a natural thing—and a good one I believe. It may not appear so to certain segments of business and industry who see other segments or geographical areas progressing faster than they are. But for the community as a whole it is a normal trend as our increased standard of living has resulted in people moving to the suburbs where they can have more room for better living. The change that is taking place in our mode of urban transportation is largely responsible, too, for the expansion of our cities. The increasing importance of the motor vehicle in our way of life has widened our travel horizons but at the same time it has, in effect, narrowed our streets.

The curve of motor vehicle registrations seems to be heading upward with no indication of a let-down. At the present rate of increase we will double the present number of motor vehicles by 1970, passing the 100-million mark in the next 16 years. A special study group recently came up with an estimate of 85-million vehicles by 1957 which assumes a reduction in the present rate of increase and is a more conservative figure. Either one of these will mean, of course, a very significant tightening in the big squeeze on our downtown streets in the years ahead.

Bigger City — Bigger Squeeze

The squeeze on our streets is worse, of course, in the bigger cities. Mr. S. T. Hitchcock of the U. S. Bureau of Public Roads cited some pertinent findings on this point in a paper he delivered at the last meeting of the Highway

BEELINE BRAND Reflective Striping Compound ready for traffic in fifteen minutes!

NO SMEARING . . . no long traffic tie-ups! This new improved pavement marking material dries faster, costs less . . . yet meets most rigid durability requirements. Apply with standard equipment. Order from your regular supplier.

PREMIXED
BEELINE
BRAND
REFLECTIVE STRIPING COMPOUND
Made by the makers of "Centerlite" Reflective Compound

IT'S A HONEY!

Made in U.S.A. by Minnesota Mining & Mfg. Co., St. Paul 6, Minn. —also makers of "Scotch" Brand Pressure-Sensitive Tapes, "Scotch" Sound Recording Tape, "Underseal" Rubberized Coating, "Scotchlite" Reflective Sheeting, "Safety-Walk" Non-slip Surfacing, "3M" Abrasives, "3M" Adhesives. General Export: 122 E. 42nd St., New York 17, N.Y. In Canada: London, Ont., Can.

3M COMPANY

Research Board. In examining the relationship of parking turnover to retail sales in 58 American cities, he found a distinct inverse relationship between parking turnover and sales as size of the city increases. The ratio used was number of parkers per million dollars G.A.F. sales (sales of general merchandise, apparel, and furniture, appliances and furnishings). The data show that when a city doubles in population, the ratio of parking to sales drops off about 25 per cent. He found less than a third as much parking per dollar of sales in a 100,000 population city as in one of 10,000 population.

The main reason for this relationship, of course, is that more people rely on buses and street cars in bigger cities. And it may that average purchases are higher, too. But the primary difference is the greater use of public transportation. You can get more customers per foot of street width, or per square foot of land, into and out of a business district by public transit than by any other means. Automobiles and parking become less important in the bigger cities.

The latest cordon count report for the central business district of Chicago shows some interesting data in this respect comparing 1951 with 1931. Although private cars bring 43 per cent more people into the district now total people entering the area has increased by a mere 7 per cent. Mass transit brings 68 per cent of all persons into the district so changes in transit riding have a much greater effect on the total than do changes in private transportation. A little over 8,000 surface transit vehicles brought 195,000 people to the district in 1951 whereas 172,000 automobiles competing for the same street space, brought only 292,000 people.

Should We Bar Autos?

It has been suggested, and maybe we will come to it some day, that automobiles be prohibited from entering congested business areas. This is not done in any cities in this country at present but I know of two places in foreign countries where it has happened. The Calle Florida, a street in Buenos Aires, Argentina, eight blocks long and 24 feet between curbs, is closed to all motor vehicles after 10:30 A.M. each day. It has two 7-foot sidewalks, too, so it is not unlike many streets in the United States. Incidentally there are two off-street parking areas at the edges of the 8-block business section and there was the usual hue and cry that went up from the retailers along Florida Street as well as from the automobile owners when the ban was first proposed. I know of one other place, High Street, in Cologne, Germany, where no vehicles are allowed between 10:00 A.M. and 1:00 P.M. and between 3:00 P.M. and 7:00 P.M. This is a major business street, about 1,650 feet long, 16.5 feet wide, and with sidewalks of 6-foot width. Off-street parking facilities are located within 330 feet of the street.

Are Core Areas Crumbling?

The importance of automobile parking facilities in core areas of bigger cities has been greatly overemphasized. The bugaboo word, "decentralization," has been overworked to the point where I think that many peope have gained the mistaken impression that our downtown areas are crumbling in decay. As a matter of fact, students of the subject tell us that much of this movement of business has been not so much a flight from bad conditions as a move to be near the populations that have taken up residence in suburban areas. Much of it has been "selective decentralization" of functions that should not be performed in high land cost areas, such as food stores, neighborhood drug stores, light industry and wholesale trade.

The truth is that since the end of World War II, municipal business district valuations have been climbing in most cases. The information I have is too spotty to enable me to make any detailed analyses, but it is enough to convince me that city cores are not degenerating in general. They are losing some business to suburban stores, but at the same time the core areas are making gains.

How Much Downtown Parking?

Granted that suburban business areas are gaining value and customers at a faster rate than core areas, and that the remedy, from the central district businessman's standpoint, will not be found in trying to match his suburban brother's parking space. Then how much parking space should he consider as fitting and proper for downtown?

I would recommend at least two criteria in determining the economical limit of downtown off-street parking capacity.

First, the physical capacity of streets is a determining factor. The number of cars that can be accommodated in parking facilities is no greater than those that the access streets can carry. In making plans for future parking capacity increases, additional street traffic volumes that would go to and from added parking spaces should be combined with other estimated future street traffic volumes and compared with street capacity. After adjustments in this capacity are made to take into account new streets and expressways, prohibition of curb parking, and other similar improvements, a very definite ceiling on future parking capacity will be indicated.

Secondly, the effect of parking facilities on public transit service must be given due account. The use of the private automobile should not be stimulated to the extent that bus or street car service is threatened. Practically all urban transit systems are losing riders each year, yet it is universally recognized that they offer the most economical means of street use. There is no precise formula I can suggest in this instance but it is suggested that before expansion of downtown parking capacity is planned, that businessmen, city officials and others assure themselves that transit service will not be unduly weakened thereby.

I know of ten communities where transit companies have folded up completely due to the competition of the automobile and other factors. In a great many other instances transit services have been curtailed for the same reasons. This encourages riders to change to private transportation which starts a vicious spiral headed toward eventual abandonment of the entire service. Certainly the effect of more downtown parking on transit service is an important consideration.

Downtown Parking Capacities

Now let us look at some comparative data for parking capacities in city business districts and outlying shopping centers. Table A shows downtown parking capacities in 43 cities, mostly under 100,000 population. Also shown is the relationship of parking capacity to city population.

Curb parking capacity averages 31 stalls per 1,000 population for these cities, off-street capacity averages 27 per thousand, and the total stalls average 56 per thousand.

The following summary shows the parking capacity ratios for 68 cities where parking studies have been made by the U. S. Bureau of Public Roads in cooperation with state and city governments.

Population Group (thousands)	Number of Cities	Average number of parking stalls per 1,000 pop. Curb	Off-Street	Total
Less than 25	20	60	34	94
25 - 50	16	45	31	76
50 - 100	5	37	27	64
100 - 250	12	17	21	38
250 - 500	8	9	22	31
500 - over	7	4	17	21
Total	68			

Using information in the 1952 Municipal Year Book (published by the International City Manager's Association) I find the following comparable average off-street parking in a cross section of cities listed in that publication.

190 U. S. Cities	25 off-street stalls
10,000 - 25,000 pop.	per 1,000 pop.
100 U. S. Cities	29 off-street stalls
25,000 - 50,000 pop.	per 1,000 pop.
52 U. S. Cities	29 off-street stalls
50,000 - 100,000 pop.	per 1,000 pop.

From the foregoing it appears that average downtown capacity per 1,000 population runs about 20 to 30 for off-street parking, curb capacity from about 5 to 70 or 80 and total capacity runs from 20 to 100 stalls per 1,000 population. Smaller cities have higher ratios and bigger cities have lower ratios.

Table B shows comparisons of parking capacities, building floor area and retail sales for a group of 18 cities. I was unable to obtain this information for all cities shown in table A. However, I believe the figures are representative because the average overall parking capacity for these 17 cities is identical with the ratio found for the 57 cities in table A and similar to the other findings cited.

Comparing the number of parking stalls to the floor area of all buildings in the central business districts (in table B), a ratio of 2.7 stalls per 1,000 square feet of floor area is found. Another way of expressing this ratio is by comparing areas, and here we find an average of 0.8 square feet of parking per square foot of floor area.

Comparison of Downtown and Suburban Parking

Table C shows parking ratios for modern suburban shopping centers. The number of stalls per 1,000 square feet of gross floor area averages 8.3, or three times the city business district average (and we are referring here to places under 250,000—the difference would be even greater for bigger cities). The area ratio for shopping centers averages 3.2, whereas cities show 0.8, only one-fourth as much parking. For these cities and shopping centers, it is apparent that parking is relatively three or four times as plentiful in the suburban as in the urban business district.

Referring to table C, there are many different ratios that can be used and I have summarized here what I feel to be

TABLE A
Parking Facilities in 57 Cities, Central Business Districts

Cities under 25,000 population	1953 Pop. (1,000)	Curb Stalls: Metered	Non-Metered	Total	Per 1,000 pop.	Off-Street Stalls: Total	Per 1,000 pop.	Spaces	Total Per 1,000 pop.
Columbus, Miss.	18	*	*	668	37	1,000	56	1,668	93
Fairfield, Ala.	19	*	*	*	*	1,300	68	*	*
Florence, Ala.	27	*	*	1,340	50	450	17	1,790	67
Gardner, Mass.	20	320	105	415	21	436	22	851	43
Hanford, Calif.	16	*	*	671	67	275	28	946	95
Hayward, Calif.	24	*	*	1,300	54	971	41	2,271	95
Homewood, Ala.	13	*	*	1,000	77	750	58	1,750	135
Huntsville, Ala.	19	*	*	640	34	330	17	970	51
Ipswich, Mass.	7	*	*	300	43	330	47	630	90
Lodi, Calif.	15	537	388	925	62	181	12	1,106	73
Menlo Park, Calif.	14	*	*	496	35	538	38	1,034	74
Modesta, Calif.	19	*	*	800	42	710	37	1,510	80
Napa, Calif.	16	*	*	843	53	416	26	1,259	79
Opelika, Ala.	13	*	*	400	31	200	15	600	46
Peabody, Mass.	23	*	*	350	15	0	0	350	15
Phenix City, Ala.	23	*	*	*	*	774	34	*	*
Salinas, Calif.	19	*	*	*	*	1,505	79	*	*
San Rafael, Cal.	16	*	*	775	49	556	35	1,331	84
Selma, Ala.	23	*	*	698	30	42	2	740	32
Sylacauga, Ala.	12	300	300	600	50	200	17	800	67
Tulare, Calif.	14	*	*	415	30	273	20	688	49
Visalia, Calif.	13	*	*	560	43	1,128	87	1,688	130
Woburn, Mass.	21	250	0	250	12	250	12	500	24
Tupelo, Miss.	12	425	400	825	69	200	17	1,025	85
Cities of 25,000–50,000 pop.									
Anniston, Ala.	34	800	300	1,100	32	670	20	1,770	52
Beverly, Mass.	29	*	*	350	12	475	16	825	28
Everett, Mass.	46	402	*	*	*	0	0	*	*
Fitchburg, Mass.	43	380	353	733	17	1,092	25	1,825	43
Florence, Ala.	27	*	*	1,340	50	450	17	1,790	67
Framingham, Mass.	30	293	884	1,177	39	2,300	77	3,477	116
Gloucester, Mass.	26	159	250	309	12	314	12	623	24
Independence, Mo.	40	*	*	963	24	1,028	26	1,991	50
La Grange, Ga.	25	*	*	650	26	60	2	710	28
Melrose, Mass.	28	188	*	*	*	400	14	*	*
Meridian, Miss.	43	*	*	1,075	25	215	5	1,290	30
Palo Alto, Calif.	31	*	*	1,100	35	850	27	1,950	63
Rome, Ga.	31	*	*	450	15	400	14	850	29
Salem, Mass.	42	*	*	497	12	1,054	25	1,551	37
Vallejo, Calif.	35	*	*	951	27	420	12	1,371	39
Waltham, Mass.	49	*	*	590	12	1,629	33	2,219	45
Cities of 50,000 – 100,000 pop.									
Columbus, Ga.	87	1,286	1,015	2,301	27	1,028	12	3,329	38
Ensley, Ala.	80	*	*	960	12	1,000	13	1,960	25
Lawrence, Mass.	81	239	*	*	*	925	11	*	*
Malden, Mass	62	*	*	690	11	1,160	19	1,850	30
Medford, Mass.	67	145	100	245	4	775	11	1,020	15
Newton, Mass	84	542	1,240	1,782	21	4,648	55	6,430	77
Quincy, Mass.	86	*	*	415	5	1,855	22	2,270	26
Stockton, Calif.	77	*	*	*	*	3,517	46	*	*
Tuscaloosa, Ala.	50	900	500	1,400	28	113	2	1,513	30
Cities over 100,000 pop.									
Fresno, Calif.	103	1,900	575	2,475	24	3,535	34	6,010	58
Jackson, Miss.	105	1,300	0	1,300	12	3,620	34	4,920	47
Lynn, Mass.	102	1,200	561	1,761	17	1,740	17	3,501	34
Montgomery, Ala.	111	*	*	3,872	35	1,545	14	5,417	49
Richmond, Calif.	111	642	1,838	2,480	22	1,009	9	3,480	31
Sacramento, Calif.	116	2,400	*	*	*	4,375	38	*	*
San Jose, Calif.	102	2,082	2,350	4,472	44	5,000	49	9,472	93
Tulsa, Okla.	211	*	*	1,078	5	3,138	15	4,216	20
Range					5 to 77		0 to 87		85-135
Average					31		27		56

* Data not given.
Source: Local Chambers of Commerce.

the most commonly used ones. Because of the wide variation in average square feet of area required per parking stall (varies between 300 and 400 generally, depending on the amount of landscaping, pedestrian walks, etc., included in the parking area), an area ratio has less meaning than a ratio of car stalls per unit of building area. However both types are shown here. The unit of floor area is sometimes confusing, so I have made a separation as between the gross floor area (including walkways, truck tunnels, boiler rooms, etc.), rental area (retail sales space plus storage area for which the tenant would ordinarily pay rent), and sales area, alone.

The Urban Land Institute recommends a minimum 3 to 1 ratio of parking to gross rental area, with 4 to 1 cited as preferable. They say 2 to 1 ratio is only suitable for exceptional cases where parking turnover is high and there is a large percentage of walk-in trade.

Planning authorities generally favor a 3 to 1 ratio of parking area to sales area, with some going as high as 4 to 1. Of course this applies only to suburban or rural areas where land is cheap and where all or nearly all people come to the area by private auto. According to a study made by John Guernsey, and reported in the "Department Store Economist," this ratio should be 3.7 for sales area alone or 2.5 for total floor area.

Parking vs. Retail Sales

The provision of parking facilities, whether in connection with outlying shopping centers or downtown areas, usually brings immediate gains in retail sales. Generally speaking one stall may be valued at from $10,000 to $50,000 in annual retail sales. Where the parking demand is great and the stores are of high quality, it is possible to arrive at the top figure by multiplying 306 shopping days per year by 6 cars turnover per day by 1.6 passengers per car by 1.5 sales per passenger by $11.40 average sale. This comes out to $50,000.

Even if we use more modest figures for turnover and average sale, we find that a parking space can be most valuable. An average turnover of 3 and an average sale per customer of $5 produces $11,000 retail sales per parking stall per year.

Sears, Roebuck and Co. have used annual retail sales of $10,000 per car stall as a criterion for planning their parking needs, and supermarkets often use $15,000 per space, according to S. T. Hitchcock of the U. S. Bureau of Public Roads. Charles E. Joern, a well-known consultant, estimates one car space will produce $15,000 in annual gross sales, based on a turnover of 6 and an average of 1½ occupants per car. David Bohannon, prominent West Coast developer, says a well planned regional center will average $10,000 in retail sales per car stall, assuming 4 cars per space per day, turnover.

These averages are commonly used to estimate the required number of parking spaces for a given area, or in planning a shopping center to be built. By dividing the total retail sales by the average assumed sales per space, the proper number of parking stalls are found. One local chamber of commerce estimated, for instance, that one parking space was needed for each $5,500 of annual retail sales.

TABLE B
Comparisons of Parking Capacity, Building Floor Area and Retail Sales In Central Business Districts of 18 Cities

City	Estimated Travel via transit	Total City Pop. 1953 (1,000)	Retail Sales - 1952 (million)	Square footage of bldg. floor area	Total Parking Stalls	Ratio, Stalls Per 1,000 Sq. Ft. of Bldg. Floor Area	Ratio pkg. area to floor area	Ratio Retail Sales per stall
Anniston, Ala.	20%	34	$40	*	1,770	*	*	$23,000
Beverly, Mass.	20%	29	$16	*	825	*	*	$19,000
Florence, Ala.	25%	27	$25	1,800,000	1,790	1.0	0.3	$14,000
Fresno, Calif.	14%	103	$217	2,236,000	6,010	2.7	0.8	$36,000
Gadsden, Ala.	20%	60	$52	*	3,004	*	*	$17,000
Gloucester, Mass.	10%	26	$15	*	623	*	*	$24,000
Hayward, Calif.	10%	24	$38	250,000 (1)	2,271	9.1	2.7	$17,000
Jackson, Miss.	16%	105	$116	1,746,200 (2)	4,920	2.8	0.8	$24,000
Huntsville, Ala.	20%	19	$45	1,600,000	970	0.6	0.2	$46,000
Lodi, Calif.	5%	15	$20	*	1,106	*	*	$18,000
Modesto, Calif.	10%	19	$97	1,000,000	1,510	1.5	0.5	$64,000
Meridian, Miss.	25%	43	$38	*	1,290	*	*	$30,000
Newton, Mass.	5%	84	$59	1,000,000	6,430	6.4	2.0	$ 9,200
Palo Alto, Calif.	20%	31	$45	1,250,000	1,950	1.6	0.5	$23,000
Salem, Mass.	65%	42	$35	726,684	1,551	2.1	0.6	$23,000
Tuscaloosa, Ala.	25%	50	$51	990,200	1,513	1.5	0.5	$34,000
Vallejo, Calif.	20%	35	$43	1,505,000	1,371	0.9	0.3	$31,000
San Jose, Calif.	20%	102	$140	5,000,000	9,472	1.9	0.6	$15,000
Range						0.6-9.1	0.2-2.7	$10,000-$64,000
Average						2.7	0.8	$26,000

Source: Total City retail sales and population data from "Sales Management Survey of Buying Power." (Further reproduction of sales figures prohibited without permission of Sales Management.) Percentage of sales in business district and other data furnished by local chambers of commerce.

*Not given.

(1) Sales space only (2) 450,000 in office space assuming 300 sq. ft. per car space.

Table B shows average retail sales per parking stall in downtown business districts of a group of cities, most of them below 100,000 in population. Sales are found to average $26,000 per car space. Of course not all sales are directly dependent on these parking spaces as some customers travel via public transit or walk to the stores. However, as indicated in the table, the percentage of transit riding is low in most cases, hence an adjustment to account for other means of transportation might be made in the average, reducing it to about $20,000 in round numbers. It is recognized, too, that not all spaces are used by customers. Employees and others who may contribute very little toward retail sales are using some of the business district parking spaces, so this average simply relates sales to total parking capacity. It is highly probable that if shopper parking facilities alone could

be isolated, that they would show a higher ratio for retail sales.

On the basis of this analysis it appears that downtown parking spaces are worth at lease $20,000 apiece in annual retail sales in cities in the general population range of 10,000-100,000 population. The value may be higher in bigger cities. However, the offsetting influence of increased transit riding would tend to detract from the average value.

Some Case Studies

It is difficult to measure accurately the effect of added parking spaces on business or property values because there are so many other varying factors that are influencing business and property at the time the parking spaces are added. However, there are a number of examples of record that appear to indicate a direct and positive relationship between parking and business and it is logical to assume that without the increases in parking, that business would not have benefited as much as it did.

For example, Silver Spring, Maryland, a community of about 75,000 population, has witnessed a spectacular rise in downtown property values concurrent with the expansion of parking capacity. Much of this, of course, was due to the rapid growth in residential populations in the general vicinity, but without adequate parking, it is certain that many of Silver Spring's customers would have done their business elsewhere. The addition of over 2,000 off-street spaces starting in 1945, has been accompanied by a spectacular rise in real estate values, the assessed value of the central business district now being over five times what it was in 1945. Land sold for about a dollar a square foot then—today it averages over five dollars.

William Deegan, City Manager of Quincy, Massachusetts, reported at the Chamber of Commerce parking clinic in Salem, Massachusetts, that after completion of a 560-stall "parkingway" in the center of this city (86,000 population) in 1950, retail sales in neighboring stores increased rapidly, up to as high as 80 per cent of dollar volume per square foot of floor space. He reported, "stores increased personnel rapidly to meet the new demands. Typical were increases from 82 to 167 employees in one retail store, from 25 to 50 in another, and from 35 to 90 in yet another.

TABLE C
Off-Street Parking Space Provided In Various Modern Suburban Shopping Centers Existing or Under Construction — June, 1953

Store & Location	Sq. Ft. Gross Bldg. Floor Area	Sq. Ft. Gross Bldg. Rental Area	Sq. Ft. Bldg. Sales Area	Parking Stalls Provided	Sq. Ft. of Parking Area (1,000)	No of stalls per 1,000 sq. ft. of building: Gross Floor Area	Rental Area	Sales Area	Parking Area to Rental Area
Atlantic Center Los Angeles	210,000	–	180,000	1,500	–	7.2	–	8.4	–
Bellevue Square Washington	125,800	–	–	1,000	–	8.0	–	–	–
Broadway-Crenshaw, Los Angeles	–	–	–	2,750	–	–	–	–	2.9
Casey's, Bismark North Dakota	60,000	–	–	400	–	6.7	–	–	–
Edgemont Park Lansing, Mich.	88,600	68,000	68,000	680	334	7.7	10	10	4.9
Edmondson Village Baltimore.	–	–	–	–	–	–	–	–	–
Evergreen Park Shopping Plaza Chicago	500,000	480,000	350,000	2,280	–	4.6	4.8	6.5	1.6 *
Fairway, Kansas City, Mo.	–	–	40,250	450	–	–	–	10.3	2.3
Franklin Simons Westport, Conn.	–	14,500	–	300	–	–	21.0	–	7.3 *
Fresh Meadows, L. I., N. Y.	–	800,000	–	2,500	–	–	3.2	–	1.1 *
Highland Village Houston, Texas.	360,000	–	–	–	–	–	–	5.0	–
Hoffman's Aurora, Col.	79,000	–	52,614	950	–	11.4	–	17.0	–
Parkington, Arlington, Va.	–	250,000	–	2,500	–	–	10.0	–	3.5 *
Hometown, Chicago Illinois	26,310	–	–	372	–	14.0	–	–	–
Hutzler's Towson, Md.	–	155,000	–	1,600	–	–	10.3	–	3.6 *
Kann's Virginia & Va. Sq., Va.	330,000	264,300	–	1,000	–	3.2	3.8	–	1.3 *
Krameria, Denver, Colo.	57,000	57,000	21,000	160	78	2.8	2.8	7.6	1.4
Lakeshore Plaza San Francisco	98,532	–	83,532	497	–	5.1	–	6.0	–
Lincoln Center Stockton, Calif.	50,000	–	40,000	400	–	8.0	–	10.0	–
McCreless Shopping Village, San Antonio	186,531	163,300	163,000	1,989	–	10.7	12.2	12.2	4.3 *
Manor Park Chicago, Ill.	56,200	–	–	400	–	7.1	–	–	–
Mayfair, Fresno, California	38,000	33,000	33,000	808	–	2.1	2.4	2.4	0.8 *
Northgate, Seattle, Wash.	800,000	775,000	650,000	5,000	1	6.3	6.5	7.7	2.3
Northland Detroit, Mich.	1,200,000	–	3,169,880	7,552	3,169,880	6.3	–	7.8	–
Prairie Village, Kansas City, Mo.	–	64,000	64,000	400	–	–	6.3	6.3	2.2*
Princeton Shopping Center, N.	205,000	–	–	3,000	–	14.6	–	–	–
Regenstein's Buckhead, Ga.	–	28,000	–	300	–	–	10.7	–	3.7*
Shopper's World Framingham, Mass	380,000	–	–	3,800	–	10.0	–	–	–
Stonestown, San Francisco.	1000,000	–	–	2,500	–	2.5	–	–	–
Village Market La Grange Pk., Ill	135,734	102,000	102,000	1,049	107	7.7	10.3	10.3	4.0
Town & Country Village, Sacramento California	–	–	–	900	–	–	–	–	3.7
University Hills Denver, Colo.	40,000	40,000	34,000	850	215	21.0	21.0	25.0	5.4
Village Shopping Center, San Angelo, Texas	72,787	90,000	73,000	1,000	350	13.7	11.1	13.7	3.9
Wanamaker's Wilmington, Del.	169,000	–	105,000	1,000	300	5.9	–	9.5	3.3*
Wanamaker's N. Shore Mart, L. I., N. Y.	–	51,000	–	600	–	–	11.7	–	4.1*
Woodward & Lothrop, Chevy Chase, Md.	101,000	101,000	70,000	1,002	350	9.9	9.9	14.3	3.5
Wynnwood, Dallas, Tex.	250,000	–		2,400	–	9.9			–
Range						2-21	2-21	2-25	1.8 – 5.
Average						8.3	9.4	10.1	3.2

Sources:
"Department Stores Economist" Reprint, Suburban Branches, Urban Land Institute Bulletin No. 20.
Various Shopping Center Developers.
*Assuming 350 sq. ft. per parking stall.

One store which reported a 60 per cent increase in personnel also reported a 158 per cent increase in sales."

The establishment of the Union Square underground garage in the heart of San Francisco, California, apparently has benefited immediately adjacent properties considerably. The assessed value of lands on the four blocks surrounding the garage increased from $3,477,810 in 1940, two years before the garage opened, to $5,023,860 in 1953. This is a 44 per cent increase while the business district as a whole increased only 18 per cent. It seems reasonable to assign a good part, if not all, of the extra 26 per cent increase to the effect of the parking facility.

According to a study by Harold Wise, a West Coat city planning consultant, the advantages of adjacent parking to retailers is well represented by two general merchandise stores in San Bernardino, California. They are competitive in every line and very similar, except that one has a 1,000-stall parking lot next to it and the other has none. Retail sales for the two were compared and it was found that the one with parking experienced an average volume of something over $90 per square foot of sales area, while the one without off-street parking averaged under $40.

In Ann Arbor, Michigan, it is reported that a small piece of business property was sold for $15,000 just before an adjacent parking structure was completed. Within six months after the structure was completed, an offer of $30,000 was made for the same property.

Conclusion

First, the solution of the "parking pickle" in downtown areas of our nation's cities does not lie in providing more off-street parking alone, and certainly not in trying to meet the complete potential demand for parking. It's not only uneconomical but a practical impossibility from the standpoint of the physical area required for storage and movement.

Suburban shopping centers provide three to four times as much parking space per unit of building floor area as is found in downtown business districts, and it is only in these new suburban centers where complete satisfaction of parker demands can be met, economically. But off-street parking is a valuable asset to downtown business when provided in quantity up to a certain point. That point is where the street access system reaches capacity or where, even with expanded street capacity, the proper role of public transit is threatened.

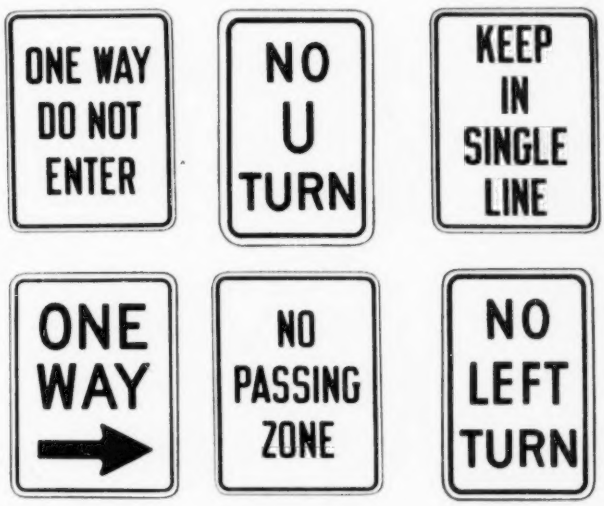
The answer to the downtown problem is not to match the shopping center's parking capacity. It rests primarily in a multiplicity of improvements aimed at obtaining more efficient use of streets and parking areas. It includes the realization that the downtown business district is a different animal from the outlying shopping center, that it has certain advantages to offer that the other place doesn't possess, and that it can hold its own through improving these features. And finally, businessmen and city officials should come to understand that the transportation pattern in downtown business districts must of necessity be different from that of the satellite shopping centers.

Night & DAY

Thousands of TASSCO Signs...clean...clear ...easily legible...regulate and guide America's motor traffic twenty-four hours a day, 365 days a year!

Nothing could be more economical than these well-made, extra-long-life signs...**the finest obtainable!**

TASSCO Signs are the result of the most modern manufacturing processes and expert engineering. Whether your need is for standard signs like these or for special signs made to specifications, be sure to consult TASSCO.



Traffic and Safety officials are invited to write for catalog.

The Sign of TASSCO Traffic Safety

TRAFFIC and STREET SIGN COMPANY
84 FOUNDRY STREET • NEWARK 5, N. J.

Grotelite
REFLECTIVE SHEETING
SMOOTH
S S
SURFACE
This highly reflective, smooth surface flexible sheeting makes a smashing, attention-compelling sign with greater day and night value. The smooth, self-cleaning surface can be screened, sprayed or brushed. It is easy to apply and makes the best long life signs and marking devices.
GREATER SAFETY
LONGER RANGE
DURABILITY
ECONOMY
Write for complete description, samples and prices.
THE Grote MFG. CO.
BELLEVUE, KY.
(Opposite Cincinnati)
STOP
STOP AHEAD

THE ECONOMY OF FREEWAYS

(Continued from page 86)

Although this report assigns no certain value to the time of the non-commercial driver, nevertheless his time is of a real value. Hence, in order to fully justify construction of this freeway it would be necessary to assign a monetary value to the time of the private vehicle driver based on what he has been willing to pay in tolls. Using the value of 5c per minute for the commercial vehicle, and 2c per minute for the private vehicle, there is a benefit of 1½c per vehicle mile, or a total of $205,000 per year. If the cost of the proposed freeway is estimated at $3,500,00 per mile, the cost will be amortized by the benefits within less than 20 years.

Comparing this section with a completed section of the Hollywood Parkway which cost $5,800,000 per mile and now carries 125,000 vehicles per day, there is found an economic justification for the high volume freeway of far greater degree than the low volume freeway. Because of the slowness and many stops on the surface streets in the congested areas, the minimum benefits to motorists on urban freeways will be double those in other areas. The traffic carried by the high volume freeway will be approximately three times as great, the unit benefits twice as much, and the cost, say, twice as much. This indicates that the heavy volume, high cost freeway has three times the economic justification to the motorist, who is the taxpayer, than the low volume freeway.

Conclusions

The preceding discussion warrants the following conclusions: (1) The economic benefits to the motorist from his investment in freeways are direct and substantial; conservative minimum savings are shown in this report to be 2c per vehicle mile; (2) There are large benefits to the region which are as real, though not easy to evaluate; (3) Heavily used freeways in congested urban areas, while much more expensive to acquire and construct, pay for themselves more quickly than lower cost freeways in areas of less intense traffic demand.

URBAN TRANSPORTATION PROBLEMS

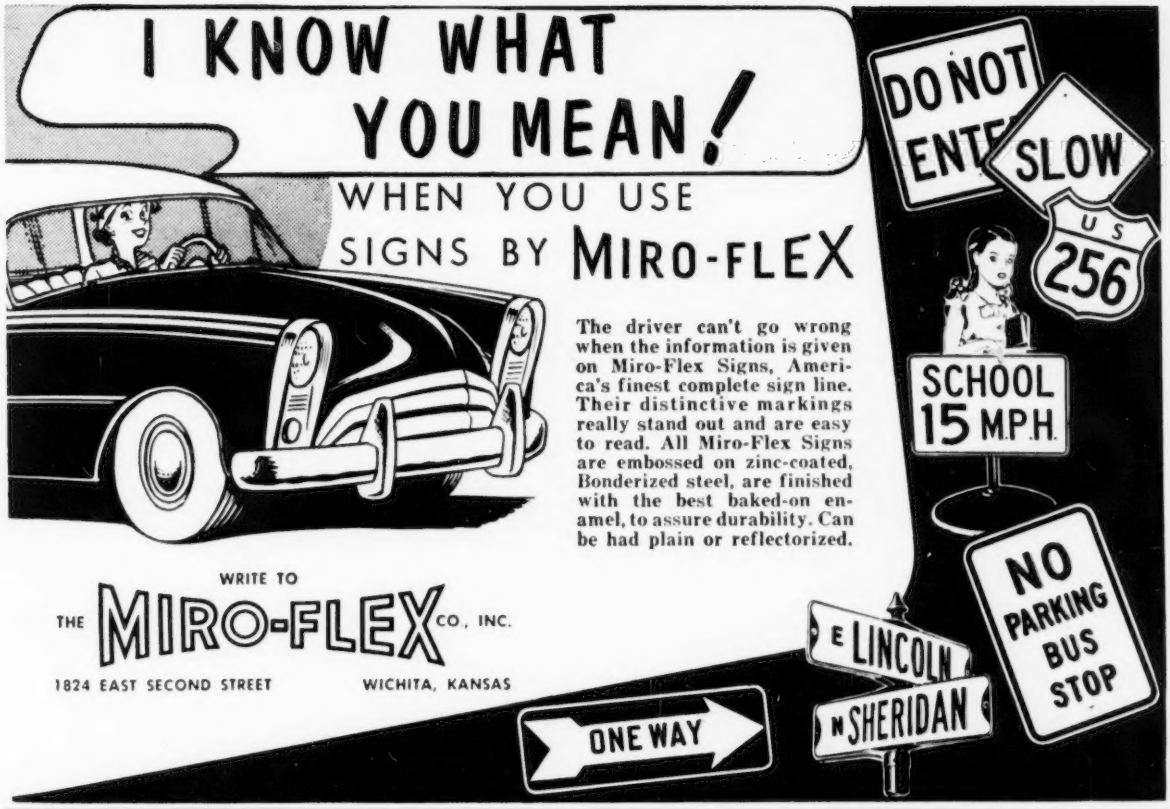
(Continued from page 88)

we call it in the local transportation system, has proven to be more efficient economically to the transportation companies than it is efficient in offering better service to the public. With the modernization program we have the problem of street congestion impeding our transportation systems.

A rubber tire vehicle is no longer fixed in its position on a street and if it is not carefully used on the street it can obstruct and impede more traffic than it was originally supposed to alleviate. The time is rapidly approaching when, in order to obtain more efficient street usage, mass transportation vehicles will have to be confined to a particular lane on the street or to designated specific streets as mass transportation routes only. The transportation industry must move faster in order to attract more users.

At the present time the traffic engineers are designing and planning tremendous expressways—expressways to handle automobiles. Unfortunately, the question of these expressways to also handle mass transportation vehicles has been given little consideration. From past experience in constructing expressways the engineering industry has found that no sooner is an expressway completed and opened for public use than the magnitude of the immediate use is what it was anticipated to be ten years hence. In other words, the minute an expressway is opened it is used almost to capacity. This does not mean there was inadequate planning or designing of expressways; it just means that the motoring public flocks to use a more convenient and faster transportation route. To increase the capacity of these expressways by additional lanes would cost fantastically much more than was expected in the original scheme. The possible solution of this problem and to the problem of arterial movements is to have the center mall for mass transportation vehicles. Recent figures published by the U. S. Bureau of Public Roads indicate that an additional acquisition of land to a center mall for mass transportation would add 8% to 10% more to the cost of an expressway. It is only through mass transportation vehicles that we can hope to expand the usefulness of the expressways, bearing in mind that one transportation vehicle is equivalent to 25-35 automobiles.

Another factor affecting the acceptability of mass transportation is the decentralization of terminal facilities of suburban carriers, both rail and bus. At the present time there are approximately 20 suburban carriers entering the central district of the City of Chicago, with different terminals. A central suburban terminal located outside of the central business district and adjacent to subway and superhighway facilities is badly needed in Chicago at the present time. This would go a long way towards alleviating the congestion on the streets in the central business district and would give the suburbanites better and faster transportation from the terminal to their places of employment. THE BIG PROBLEM IS MOVING PEOPLE!


I KNOW WHAT YOU MEAN!
WHEN YOU USE SIGNS BY MIRO-FLEX
The driver can't go wrong when the information is given on Miro-Flex Signs, America's finest complete sign line. Their distinctive markings really stand out and are easy to read. All Miro-Flex Signs are embossed on zinc-coated, Bonderized steel, are finished with the best baked-on enamel, to assure durability. Can be had plain or reflectorized.
DO NOT ENTE
SLOW
US 256
SCHOOL 15 M.P.H.
NO PARKING BUS STOP
E LINCOLN
N SHERIDAN
ONE WAY
WRITE TO
THE MIRO-FLEX CO., INC.
1824 EAST SECOND STREET WICHITA, KANSAS

Letter to the Editor

Sir:

I was interested in Henry W. Osborne's article on Buffalo's truck route system published in the September issue of TRAFFIC ENGINEERING — and the motives and reason for adopting it.

St. Paul, Minnesota, population 314,000, adopted such an ordinance July 17, 1941 "for the protection of property, the preservation of peace and order, the benefit of trade and commerce, the preservation of public health and safety and to promote the general welfare, comfort and well being of the City of St. Paul and its inhabitants by defining, regulating and restraining the movement of commercial vehicles and the use of streets, public thoroughfares, highways and places by such commercial vehicles."

Commercial vehicles are defined as a "self-propelled" motor vehicle having a manufacturer's rated capacity of over two tons and any truck tractor or road tractor or combination of truck or road tractor and tractor or semi-trailer designed for carrying commodities other than people, whether laden or unladen." The ordinance is flexible, providing a police permit for a special load over a designated route.

The ordinance specifies 32 truck routes and in addition permits commercial vehicles in areas zoned for commercial purposes or light or heavy industry under the building zone code. The routes and maps are furnished truck companies instead of signing the streets.

The ordinance was prepared by the City Planning Board in cooperation with the truckers and the Police Department. In St. Paul there are large trucking terminals concentrated in what is called the Midway district, a heavy industry district lying midway between the central business cores of St. Paul and Minneapolis. The metropolitan district has a population of 1,200,000. Over-the-road trucks moving from terminals north, east or south must pass through parts of the city of St. Paul which has a rugged terrain. Prior to the truck zone regulation, the trucks used the streets and thoroughfares that suited their convenience or the notion of the drivers. Now the terminal dispatchers specify the route the driver is to take.

St. Paul's comprehensive zoning ordinance regulating the use of property, etc., by zones or districts was passed in 1922. As this ordinance became more and more effective, it was apparent that the use of streets should also be zoned to conform to the use of property abutting. Zoning regulates the intensity of the use of the street in conformity to the use of the property. My thesis is that City Planning aims to preserve a proper balance between the amenities of living and a system of free enterprise. Perhaps the next step will be to zone streets to conform to their capacity when we have thought up a way of doing it.

The St. Paul Truck Route Ordinance received its real test during World War II. Several trucking companies thought it might be possible to have the ordinance annulled because of alleged over use of gasoline and wear on tires in following the designated routes. They appealed to the Bureau of Transportation, Interstate Commerce Commission and got a hearing. The City Council of St. Paul was asked to relieve the situation by the Bureau. As Director of City Planning, I was asked to prepare a brief on the actual situation, which I did; and which was submitted to the Bureau with a map showing intra-city routes and their connection with trunk highways leading to main markets and a copy of the ordinance. This brought a reply from the Bureau of Transportation that the city make no change in this ordinance.

G. H. Herrold
Planning and Zoning Consultant
St. Paul, Minnesota

Shopping Center

SLOW DOWN AND SHOP, YES, SIR, PROFESSOR T. R. AFFIK HAS DESIGNED THIS NEW AND FABULOUS SHOPPING CENTER FOR YOUR EXCLUSIVE USE. BELIEVED TO BE THE WORLD'S LARGEST BUSINESS DISTRICT IN EXISTENCE, THE TRAFFIC ENGINEERING SHOPPING CENTER WILL EVENTUALLY HOUSE OVER ONE HUNDRED EIGHTY DIFFERENT PRODUCERS OF TOOLS FOR AN EFFECTIVE TRAFFIC CONTROL PROGRAM. CAUTION, SHOPPING CENTER AHEAD — A NEW AND BETTER AND ADDITIONAL SERVICE TO YOU THE READER—THE TRAFFIC ENGINEER.

Proffesor Affik says be sure to stop at the SHOPPING CENTER every month. To do any free window shopping or credit buying, just rip. snip or clip the enclosed coupon and mail to SHOPPING CENTER, TRAFFIC ENGINEERING, Strathcona Hall, New Haven 11, Conn. If you prefer, you may contact the proprietor himself. There are no "hidden" taxes, so go right ahead and write to the proprietors as listed in the "Largest Shopping Center in the World."

| — Rip — Snip — Clip — Rip — Snip — Clip — Rip — Snip — Clip — Rip — Snip — Clip — Rip — Snip — |

Clip

1 2 3 4 5 6 7

8 9 10 11 12 13 14

Clip

Snip

Name _____ Title _____

Address _____

Snip

Rip

Rip

| — Rip — Snip — Clip — Rip — Snip — Clip — Rip — Snip — Clip — Rip — Snip — Clip — Rip — Snip — |

1.

G-E Type W Controller Offers Semi-Vehicle Actuation with the Simplicity of the Famous Type F

Simplicity of jack-mounting and unitized construction pioneered in the famous G-E Type F traffic controller, has been incorporated into G.E.'s new semi-vehicle-actuated controller — the Type W. This electro-mechanical controller uses basic parts, such as the timing dial units and signal drum assembly, which are mechanically identical to those of the famous Type F Controller.

Ideal for intersections where signalization is required to enable motorists to cross or gain access to the main thoroughfare, the Type W is also available in fully-actuated models.

More information is available at your nearest G-E Apparatus Sales Office or Traffic Control Distributor. Or write for Bulletin GEC-941, to Section 453-60,

GENERAL ELECTRIC COMPANY
SCHENECTADY 5, N. Y.

2.

For Traffic Marking, Select Prismo

When Traffic Experts in America's cities embark on a traffic marking project, they usually select PRISMO Quick Drying Municipal Life-Line. It's because of the advantages of Prismo, the originator of reflective markings. Yes, these safety planners know what they can expect from Prismo's "Moisture-Proof" striping and many other exclusive features. They know from experience that they will get immediate maximum brilliance night and day, the longest lasting and the most economical. Write for complete information.

PRISMO SAFETY CORPORATION
HUNTINGDON, PENNA.

3.

All-Rubber Traffic Guides For Emergencies

Wherever traffic control becomes difficult . . . during rush hours, street repair or emergencies, the Safe-T-Cone "steel-like" rubber traffic control is on the job to demand the motorists' respect. Available in two sizes, 18 inch and 28 inch, painted or reflectorized.

RADIATOR SPECIALTY COMPANY
CHARLOTTE, NORTH CAROLINA

4.

Make the "Traffic Sentry" Standard Equipment for Your City

The "Traffic Sentry" PORTABLE TRAFFIC SIGNALS are easily handled by one man. Use them in case of emergency, spot congestion, during rush hours, and when there are detours. Easy to wheel off the street when not in use, they are either automatic or manually controlled. Self-contained battery charger, 110 volt. Write for complete data:

PORTABLE TRAFFIC SIGNALS, INC.
1620 SOUTH HILL ST.
LOS ANGELES 15, CALIFORNIA

5.

Jawco Gives You Low-Cost One Man Operation

The JAWCO Lightweight Traffic Liner, with 5 gallon capacity, combines ease of operation with low initial, maintenance and upkeep costs.

One inexperienced man can easily give you smooth, even, straight traffic and zoning lines with a JAWCO Lightweight Traffic Liner. Inquire today! For further information, delivery date and price, write

WEAVER MACHINE COMPANY
P. O. BOX 1224, YORK, PENNA.

6.

"Via Port of New York" On Film

"Via Port of New York," a twenty-seven minute film in color, is the first motion picture to tell the complete story of the land, sea and air shipping facilities and services available in the largest and busiest port in the world. The film depicts the Port of New York Authority District of New Jersey and New York as the business and financial center of the nation, as a vast consumer market and manufacturing area and as the center for the endless movement of goods and raw materials. This unique film is an education in itself, available without charge to civic, service, and fraternal clubs, as well as to colleges, high schools, church groups and other organizations. Bookings may be arranged through the distributor,

UNITED WORLD FILMS
1445 PARK AVE., NEW YORK CITY

7.

Viz-U-Lizer Can Help You

The Accident Viz-U-Lizer enables you to re-enact any type of traffic accident—pedestrian, auto, street, highway, etc.—shows you how the accident occurred. Used by insurance companies, lawyers, traffic educators, traffic engineers and many others throughout the country, this "Viz-U-Lizer" board comes in two sizes: three sections 14" x 22" or 9" x 14." For further information write:

SALES-AID COMPANY
P. O. BOX No. 1142
TRENTON 6, NEW JERSEY

8.

"Vertical Parking Garages" Book

"Vertical Parking Garages" is the title of a book that has just been written by Charles W. Lerch, President of the Charles W. Lerch & Associates, Chicago. It takes up the question of what parking facilities are most successful in relieving the extreme shortage of parking space in our cities.

The leading various types of vertical parking are described in detail and the advantage of each type is fully described. Additional suggestions and statistics helpful to the study of public garages are offered.

A copy of this book of great value to municipal officials, Chamber of Commerce officers and garage owners will be sent if a request is made to

CHARLES W. LERCH
1172 BOARD OF TRADE BUILDING
CHICAGO 4, ILLINOIS

Traffic Authorities and City Officials

The **Portable Traffic Signal that meets YOUR Standards**

SPECIFICATIONS

Height—9' 2" overall.
Two 8" wheels with rubber cushion tires.
Completely automatic; also manual control.
Self-contained battery charger, 110-volt.
Heavy-duty 6-volt battery, which will operate signal 18 hours continuously.

Easy on the traffic officer.
Easily handled by one man.
Easily wheeled off the street when not in use.
Easily transported to distant emergency spots by trailer.
Of course it's a portable signal.
In every essential respect it is a regulation-size traffic signal.

"TRAFFIC SENTRY", the portable traffic signal built by Portable Traffic Signals, Inc. was designed, constructed, and is sold to meet the standards set forth in the *Manual on Uniform Traffic Control Devices for Streets and Highways.*

Write for all the facts:

PORTABLE TRAFFIC SIGNALS, INC.
Manufacturers of the "Traffic Sentry"
1620 South Hill Street — Los Angeles 15, Calif.

9.

Advantages of Traffic-Actuated Control

Busy 3-movement intersections need Electro-Matic 3 phase control. The advantages of traffic-actuated control are especially outstanding in handling intersections where three independent traffic movements are necessary to prevent danger and congestion. Depending upon traffic volumes and other conditions, AUTOMATIC SIGNAL DIVISION has for your problem a choice of Electro-Matic Model 826D Dispatcher, or Volume-Density Model 1033 Dispatcher. Write for literature on these Models:

AUTOMATIC SIGNAL DIVISION
EASTERN INDUSTRIES INC.
NORWALK, CONN.

10.

Tuthill Hyway Guard Keeps Them on the Road

Finely paved road surfaces correct fills and scientifically engineered grades are not alone sufficient for the modern high speeds to insure the highway user complete safety against road hazards. Proper protection of danger spots is absolutely vital to promote driving safety. For extra strength where extra strength is needed, TUTHILL Hyway guard keeps them on the road. Tuthill Guard Rail has been on the market for the last twenty years; of the non-tension type, it requires no end anchorage. Write for full details and prices to:

TUTHILL SPRING COMPANY
760 POLK STREET
CHICAGO 7, ILLINOIS

Only red stop signs have been used in the State of California for many years. U.S. Porcelain Enamel Company's twenty five years experience producing red stop signs will give you longer lasting, lower cost signs.

Day or Night

RED IS RIGHT

Wherever you go the color red is the one universally recognized indication to stop...the one indicator that puts *extra* caution into every motorist.

More and more, city, county and state traffic and safety engineers are recognizing the importance of adopting red as the basic color for all stop signs. The demand is rapidly growing for the *plus* safety features of red stop signs reflectorized with "Scotchlite" reflective sheeting.

Only with "Lifetime" Porcelain Enamel do you get rugged, nonfading long-life construction plus the extra visability and extra safety of red stop signs reflectorized with "Scotchlite."

Write today for full information and prices on U.S. Porcelain Enamel stop signs.

Compare our price... $8.50 ea in lots of 25—delivered

U.S.
U. S. PORCELAIN ENAMEL CO.
4635 E. 52nd Drive • Los Angeles 22, Calif.

11.

The Wise Choice Is Karpark

Good, Better, Best—the difference is in a machine's performance, and performance depends on the way it's made. The superior performance of KARPARK meters in dependability, accuracy, and in long, trouble-free operation, is the result of meticulous methods and high precision skills. KARPARKS are made by the craftsmen of The Herschede Hall Clock Company with the exacting workmanship that produces America's finest clocks. The Twin-O-Matic, shown above, is one of four great KARPARK meters. Now available to many more cities, it offers the economy of one installation for two car parking plus many special features. Write for complete information.

THE KARPARK CORP.
CINCINNATI 6, OHIO

12.

Signs That Guide, Signs That Tell

Beautiful full-color signs that shine at night, tell you where you are, or signs that guide you through traffic—both day and night. That's one of the many reasons why you will want reflectorized signs, route markers, or traffic and warning signs made with "Scotchlite" Sheeting. Impressive by day, these signs are *breathtakingly beautiful* at night as car headlights kindle them into full color. Get facts from:

MINN. MINING & MFG. CO.
ST. PAUL 6, MINN.

13.

Ever Visible "Vitamic" Traffic Markers Outlast The Pavement

These dome-shaped, glazed vitreous ceramic pavement inserts have nearly twice the wearing qualities of granite. Easily installed in existing or new pavements, they provide all weather visibility both day and night. The glazed surface is so smooth and impervious that it sheds dirt and grime, keeping the markers always bright and conspicuous. Hardness and crushing strength are so great (24,000 lbs psi), that markers are immune to abrasion, shock and wear of the hardest traffic.

THE LOFLAND COMPANY
P. O. BOX 1210
5219 MAPLE AVE., DALLAS, TEXAS

14.

Remington Rand Can Protect Your Plans and Drawings

When it comes to safeguarding your most valuable plans and drawings, remember, there's only one sure protection . . . a *certified* fire-resistive cabinet that protects them 24 hours a day.

Ordinary steel units offer no protection. Steel transmits heat—and paper chars at temperatures as low as 300° F.

The REMINGTON RAND Safe-Cabinet Map-and-Plan Unit represents the safest, surest protection made. It is certified by the Underwriters' Laboratories to protect paper contents against heat of 2000° F. for at least 4 hours. *Certified* against impact too—even though it should drop 30 feet while white-hot.

Fire can strike without warning—be prepared for it. Send for Booklet SC688, describing this sure protection. See how easily you can have it—then decide whether you can afford to be without it.

REMINGTON RAND
ROOM 1262, 315 4th AVE.
NEW YORK 10, N. Y.

TRAFFIC PRODUCTS AND NEWS

Texas' First Tunnel

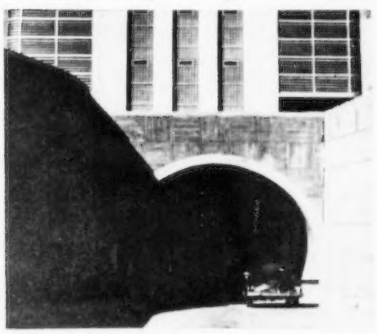
Austin, Texas' new multi-million dollar tunnel between Baytown and La Porte was opened with a formal ribbon cutting ceremony on Tuesday afternoon, September 22.

Costing $10,013,149 the new tunnel is one of the world's largest subaqueous tubes, and is the longest in Texas. The Texas Highway Department, the Federal Government and Harris County shared the expense of the tunnel; with the Highway Department putting up $4,055,649; matched by $3,057,500 in Federal Aid, and $2,900,000 from Harris County.

The tunnel proper is 3,009 feet in length from portal to portal, with open approaches 551 feet long on each end. The overall length of the project, including approaches, is seven miles.

A unique feature of the construction is a three-level traffic exchange on the La Porte side. This is the only exchange of its type in Texas and will be one of the few in the world.

The roadway through the tunnel



measures 22 feet from curb to curb, with a minimum vertical clearance of 14 feet at the curb line. The exit lanes widen from 11 to 23 feet beyond the portals to provide a second line of traffic for slow-moving vehicles.

The one-half inch steel tunnel tube is 35 feet in diameter and acts as a form for the three feet of concrete which is the tunnel proper. The steel tube sections were fabricated at Orange, towed to the site, sunk into place in a dredged trench and then finished.

Six of the nine tube sections are 300 feet long and the three center sections, each having been constructed to fit the alignment curve, are 252 feet in length. The bottom of the tunnel is 89 feet below the surface of the water at mean tide.

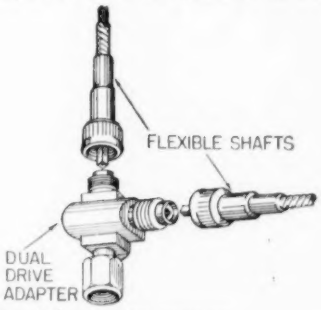
The sections were sunk end-to-end, bolted together, then made water-tight with a special type of concrete. The empty structural steel in the tubes weighed 4½ thousand tons, which is enough steel to build a four-strand barbed wire fence around the state of Texas.

The 52,270 cubic yards of concrete used would build a two-lane highway 20 miles long, and the 1¼ million tiles used would build nearly 5,780 average bathrooms. Dirt and sand dredged out to make room for the tunnel, if placed on a football field, would make a pile about twice as high as the San Jacinto monument.

A six story building housing the controls is located on the Baytown side. It has three stories underground and three above the ground level which house the ventilation, pumping system and other operating devices for controlling the tunnel.

New Dual Drive Adapter

The F. W. Stewart Manufacturing Corporation announces a new "Circle Ess" Dual Drive Adapter for use in conjunction with flexible shaft drives where more than one unit is to be driven from the same power source; to provide two ratios from the same source or to facilitate attaching flexible shaft drives where limitations in space prevent direct connection without bending the shaft to the point of possible danger. Furnished with standard 5/8" x 18 threaded connections with .104" internal square drives and in ratios of 1 to 1, 15 to 1, 16 to 1, and 17 to 1 for



either left or right rotation.

The body is aluminum alloy with brass connectors and the hardened steel gears run in oil-lite bearing which are permanently lubricated for high and low temperatures. The weight is 4 ounces.

Dur-O-Line Markers Used For New York City

A two year run on Broadway is considered a success in any man's language. However, it appears two years is only the beginning in the case of Dur-O-Line Traffic Markers that have undergone a test in the great city of New York to determine their ability to withstand the heavy traffic wear only the city of New York can give them.

The city of New York has completed installation of these solid plastic discs to designate pedestrian lanes across Times Square, Herald Square and Madison Square, and is now installing them to designate school safety lanes. Additional installations are planned, all as a result of a very successful two year traffic test.

In the words of Patrick H. O'Leary, traffic control engineer of New York's department of traffic, "More than two million vehicles a month passed over these markers since they were first installed in 1951, and they are still in good condition. If painted lines were there, they would have to be renewed at least once every thirty days, possibly twice in the event of continued adverse weather, to retain proper legibility."

The plastic traffic markers used in the highly successful New York experiment are manufactured by Traffic Safety Supply Company, Portland, Oregon.

Duro-O-Line traffic markers used to designate pedestrian lanes across Times Square, Herald Square and Madison Square in New York City.

The firm of Parsons, Brinckerhoff, Hall & MacDonald designed and supervised the tunnel with Engineers W. H. Bruce and Ray Lyons in charge of the project.

Brown & Root, Inc., Houston engineers and contractors, held the contract to build the tube proper, while Farnsworth & Chambers Company, Inc., also of Houston, held the contract for finishing the tunnel. Both firms shared in the approach road contracts.

BUSY 3-MOVEMENT INTERSECTIONS NEED

MODEL 826D

ELECTRO-MATIC® 3 Phase Control

The advantages of traffic-actuated control are especially outstanding in handling intersections where three independent traffic movements are necessary to prevent danger and congestion. Depending upon traffic volumes and other conditions a choice of ELECTRO-MATIC MODEL 826D DISPATCHER, or VOLUME-DENSITY MODEL 1033 DISPATCHER is available.

The following illustrates how right-of-way is transferred under varying conditions of traffic demand. Note that phases are skipped on which no traffic is present. Each phase has time extension and memory. A typical four-interval signal color sequence is used. G, Y, and R stand for green, yellow, and red signals.

(a) It is assumed that demand is present on each traffic phase. Note that the dispatcher includes each phase in the cycle.

Period :	1	2	3	4	5	6	1
Street A:	G	Y	R	R	R	R	G
Street B:	R	R	G	Y	R	R	R
Street C:	R	R	R	R	G	Y	R

(b) Here it is assumed that when the green light is ready to leave Phase A there is demand on Phase B, but when ready to leave Phase B, there is no demand on Phase C. Therefore Intervals 5 and 6 for Phase C are omitted from the cycle, and the green light skips to Phase A where there is a demand.

Period :	1	2	3	4	1
Street A:	G	Y	R	R	G
Street B:	R	R	G	Y	R
Street C:	R	R	R	R	R

(c) In this example, when the green light is ready to leave Phase A there is no demand on Phase B, so Intervals 3 and 4 for Phase B right-of-way are skipped, and the green light goes to Phase C in response to demand there. From Phase C it goes to Phase A where there is also demand.

Period :	1	2	5	6	1
Street A:	G	Y	R	R	G
Street B:	R	R	R	R	R
Street C:	R	R	G	Y	R

(d) The assumption here is that there is demand on Phases B and C, but temporarily no demand on Phase A.

Period :	3	4	5	6	1
Street A:	R	R	R	R	R
Street B:	G	Y	R	R	G
Street C:	R	R	G	Y	R

MODEL 1033

Write for literature on Models 826D and 1033

TRAFFIC ACTUATED®

Automatic Signal Division
EASTERN INDUSTRIES INCORPORATED
NORWALK, CONNECTICUT
In Canada, Northern Electric Co., Ltd., Belleville, Ontario

New Method for Handling Shuttle Traffic

Colonel S. H. Bingham, AUS (Ret.,) General Manager, New York City Transit Authority, and Consultant, Long Island Transit Authority, in a recent address to the New York Chapter of the New York Society of Professional Engineers, described his own development of a more efficient method for handling the Grand Central-Times Square shuttle traffic. Following is that portion of the Colonel's speech on Future Transportation For Our Cities that includes the accomplishments thus far on this unique conveyor system.

—EDITOR

Our Grand Central-Times Square shuttle needs rehabilitation and modernization and is very expensive to operate. In studying this problem I sought means to develop a more efficient method of handling this shuttle traffic.

The shuttle is one of the more heavily used sections of the transit system, carrying 60,000 people per day in each direction. It is a closed system so that a special transit method developed for the shuttle could be applied without affecting the other parts of the system. It was my desire to devise a way of carrying the passengers within the space occupied by the two center tracks of the four-track route, so that the outer tracks could be converted to walk-ways and air raid shelters.

Some kind of conveyor system seemed to offer a possible solution. Its continuous operation features offered high capacity in a small space, and the low operating manpower requirements would result in a low operating cost.

We know that many passenger conveyor ideas had been suggested and some moving sidewalks and similar schemes actually operated, usually at expositions.

But there was nothing proposed, or in existence, that seemed to offer any practical application for the shuttle.

I suggested to the Goodyear Tire and Rubber Company and the Stephens-Adamson Manufacturing Company, who had solved many industrial conveyor problems, that this was a fertile field for study.

The major problems were to develop a passenger conveyor system that could handle over 12,000 passengers per hour in each direction with present subway standards of safety, would give a speedy, comfortable and convenient ride, would be cheaper to operate than the present shuttle, and would not cost more than the conventional rehabilitation previously studied for the shuttle. It would also be desirable to fit this system into about half the space now occupied by the shuttle.

The conveyor system that was designed and is now under detailed development satisfies all of these conditions.

It will carry 16,000 passengers per hour in each direction at least as safely, and more comfortably, than the subway. Passengers will make the trip in two minutes, with no waiting for trains. The present shuttle trip is two minutes of running time, plus the waiting time between trains. We estimate that operating and maintenance costs will be 40% of present shuttle costs, and that installed in existing tunnels, the cost of the conveyor equipment is less than 60% of conventional subway equipment. The proposed conveyor will occupy only the two center tracks of the shuttle. The remaining two trackways will be converted to well-lighted, air raid shelters and walk-ways so that adjoining basements become potential shops that can increase business and tax revenue to the city.

The proposed system differs from previous passenger conveyor proposals in that the passengers will ride in cars carried on belts and on banks of rubber tired wheels.

Conveyor belts are used at low speed for passengers and cars at loading and unloading areas and at high speed to transport the cars from station to station. Banks of wheels, equipped with pneumatic tires, accelerate and decelerate between conveyor belts moving at different speeds, and carry the cars around all turns.

Passengers at stations will walk upon the moving belts which have a speed of about one and one-half miles an hour. Parallel to and moving at the same rate of speed is the car loading belt. Riding on this belt are seven foot square, ten seat passenger cars. Nineteen cars pass the loading area every minute.

Passengers step from the loading belt into a car which is empty as it arrives at the loading area and is moving at the same speed as the loading belt. Doors open automatically when the cars reach the loading area and then slowly close prior to the time the cars clear the loading area. The passenger loading belt is nine feet wide and sixty feet long. The car loading belt is of the same length, but only five feet wide, so the cars overhang the belt both front and back, and fit snugly against the passenger loading belt. The cars are closely spaced, bumper to bumper, as they pass the loading area.

Once clear of the loading area, the passenger cars are rolled for about 50 feet over a bank of pneumatic tired accelerator wheels which quickly steps up their speed to 15 miles an hour. The acceleration is at the comfortable rate of two and three-quarter miles per hour per second. Spacing between the cars is increased as they are accelerated and they then ride on the main line conveyor belt, running at 15 miles an hour. This endless high speed belt transports the cars between stations.

At the other station, the passenger cars are slowed down at the same rate in a 50-foot run over a bank of decelerator wheels and are delivered bumper to bumper on the car unloading belt moving at approximately one and one-half miles an hour. The car doors open and passengers step out onto a passenger unloading belt moving at one and one-half miles an hour, the same speed as the cars, and walk or ride to the exit at the end of the belt. The passenger and car unloading belts are the same dimensions as the loading belts.

The empty car is then carried around a loop at the end of the shuttle system on a bank of wheels and deposited on the car loading belt ready to carry another load of passengers. The continuous flow of cars eliminates waiting and platform congestion.

I first broached this idea to these companies in 1948. It took until 1951 to develop a plan on paper that seemed workable and overcame the hurdles of safe passenger loading and unloading on moving belts, and on ways of accelerating and decelerating the cars.

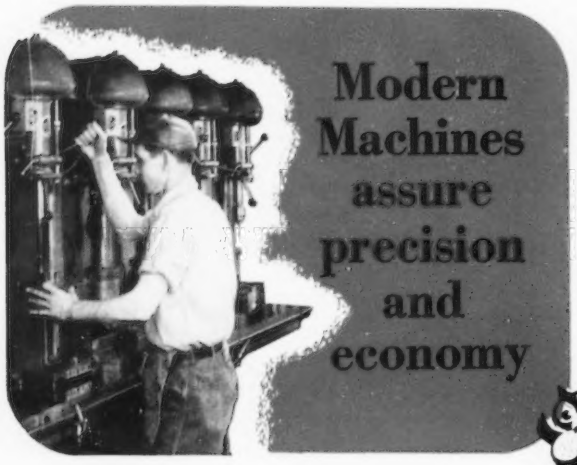
In April of this year a working model that proved the feasibility of the design was shown in New York City.

During the many months of exhaustive engineering to perfect the conveyor belt subway plan, full-scale testing equipment to solve human element problems was built.

A rubber conveyor belt 60 feet long and nine feet wide and a mock-up of five full-size cars were set up for human engineering. The cars operated adjacent to the belt duplicating actual loading and unloading conditions on the New York City subway belt system.

An accelerating and decelerating system was built to determine the maximum rate at which a passenger car could be speeded up and slowed down on a conveyor belt system.

These test installations proved the workability of the subway belt system.



Modern Machines assure precision and economy

Careful Inspection safeguards quality

THE WISE CHOICE

Assembled and Tested for perfect performance

Every part made with exacting craftsmanship

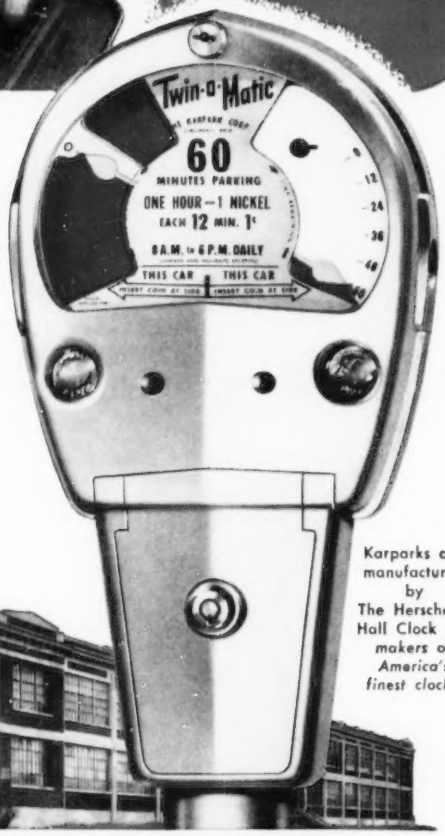
Built to give "extras" in results

Extra care in the making provides the "extras" in accuracy, sturdiness, dependability and true economy that make Karparks the choice of far-sighted officials. Four models — Superior, Husky, Twin-O-Matic, Unimatic — have every worthwhile feature.

Again Available — The Versatile

Twin-O-Matic

A greater flow of materials makes it possible for many more cities to have this feature packed, two-car parking meter. Write for data.



KARPARK *Automatics*

THE KARPARK CORPORATION, CINCINNATI 6, OHIO
IN CANADA
TWIN METER CO. OF CANADA LTD.
1224 Ropery Street
Montreal 22, Que.

Karparks are manufactured by The Herschede Hall Clock Co. *makers of America's finest clocks.*

Durasigns Are New Idea

A new and revolutionary Sign panel, of rustproof fiber glass reinforced material, is now in production by the Nu-Bone Company, Inc., Erie, Pennsylvania. Trademarked DURASIGN these panels are strong as steel but weigh only one third as much. They never require painting as the color goes all the way through. Officially approved by State Highway Departments for Traffic Control Sign use, they are also ideal for any other sign application where strength and weather resistance are important. Since DURASIGNS are rustproof and corrosion proof they are particularly applicable for ocean side installations where salt spray quickly ruins the conventional metal sign. Cost is competitive with comparable metal signs but lighter weight results in an appreciably lower net cost due to transportation savings.

Durasign in Action!

Hundreds of tests were made with all kinds of people, old and young, nimble and lame, carrying packages and leading children, and it has been determined that a belt conveyor is the most efficient and least costly means of moving large numbers of people over short distances.

There is no reason why such a conveyor system cannot be extended to longer systems with way stations. All that is required for a way station is a bank of decelerating rollers, low speed unloading and loading belts, and accelerating rollers.

Similar and simpler passenger conveyor systems are being developed for large parking fields, airports, railroad terminals, stadiums and other locations where great numbers of people have to be moved quickly and cheaply.

New Manual Available

A completely revised and greatly expanded edition of the "Manual of Traffic Engineering Studies," the only comprehensive reference treating on the methods, forms, and analysis of traffic studies essential to a factual approach to the solution of traffic problems, is now available.

This book has been written, and reviewed by nationally known traffic and transportation engineers, in clear and simple language. The result is a truly indispensable everyday guide for police, engineers, planners, transportation officials, and students.

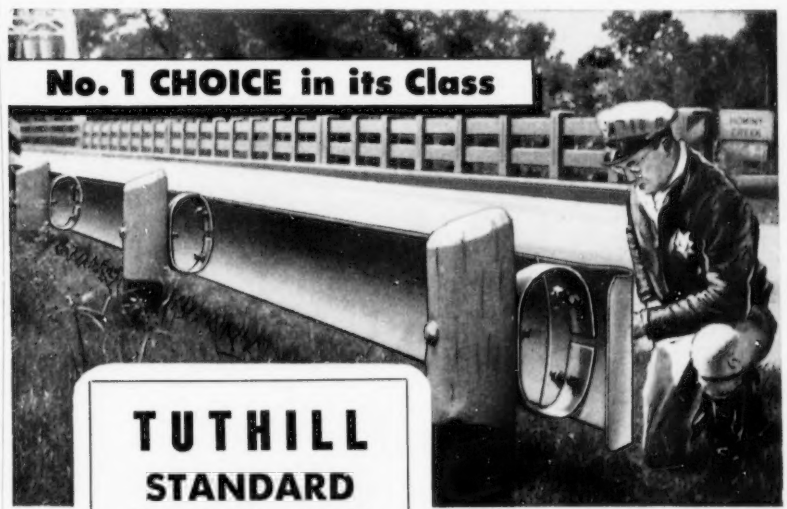
Featuring 253 illustrations and 27 tables, the 278 page Manual covers 28 different traffic studies successfully conducted by recognized practicing traffic engineers. Studies covered include accident records and facts; high accident frequency locations; driver observance of stop signs, speed reduction signs, and traffic signals; motor vehicle occupancy, volume, and volume capacity; cordon count; pedestrian volume; transit loading, boarding and alighting, and speed and delay.

Other studies treated include motor vehicle spot and over-all route speed; major route congestion; through traffic; origin and destination; business district two-man parking check; parking inventory; street and off-street parking; employee and customer parking; parker and business district questionnaires; parking lot analysis; and staggered hours.

In addition, other sections deal with the origin, financing, and planning of surveys, as well as the analysis of traffic trends, statistical treatment of traffic data, comparing before and after studies, drawing up questionnaires, and preparation of effective traffic study reports.

The first edition of the "Manual of Traffic Engineering Studies" was published in 1945 by the National Conservation Bureau, now the Accident Prevention Department of the Association of Casualty and Surety Companies, as a successor to the original "Traffic Survey Manual."

A completely rewritten volume, the 1953 Manual has been expanded 135 per cent to incorporate the multitude of significant developments in traffic studies which have occurred since the the original edition was published.



TUTHILL
STANDARD
GUARD RAIL
(No. 4 Spring Bracket Shown)
Write today for Technical Brochure

Designed to meet Public Road Administration specifications for spring mounted Beam Type guard rail. Stiffer than standard-type TUTHILL brackets, the No. 4 gives shock-resistant deflection for rail, cushions shock to vehicle and occupants. Superstrong Hyway Guard requires only single bolt through post, little or no maintenance.

TUTHILL SPRING CO.
760 W. POLK STREET • CHICAGO 7, ILLINOIS

Buffalo Rears Its Ugly Head!

Late comers garbed in appropriate dress: (L. to r.): Hank Osborne, Nat Cherniack, Skinny DeYoung, Lou Andriacchi, John Mitton and George Howie.

Hilarious Head-waiter adds spirit to early bird Biscuit Banter Breakfast.

Bob "Joe Prismo" Higgenbottom presents to Sam Nowell valuable door prize. Elderly bald-headed men, Bob Schmidt and Bob Holmes, et al., watch enviously.

SECTION NEWS

LOCAL STUDENT CHAPTER IS ORGANIZED

Despite the many legislative and gubernatorial political races that were in the headlines during October and November, a very important event recently took place when the nineteen Yale Bureau of Highway Traffic students elected the following men to serve as their officers in this year's Local Student Chapter of the ITE. President, Robert H. Conradt; Vice-President, Colonel Arthur L. Baker; Secretary, William G. Galloway; and Treasurer, Stig R. Nordqvist. Mr. Walter Schwanhausser of the General Electric Company lectured to the new students at a special meeting last month. During the meeting Mr. Schwanhausser invited the students to attend their three day traffic school at Lynn, Mass. This year's Chaplain, James M. Hunnicutt, Jr. made a motion that there be 100 per cent attendance at the session, providing there were no required written reports to be submitted. Motion was passed, with Colonel Baker abstaining! Following is a list of the students attending the Bureau this year:

Baker, Arthur L.—Lt. Col. Terminal Water Transport Service Division, Office of Chief of Transportation, Washington 25, D. C.

Boulding, Ernest A., Jr.—Senior Engineer, Traffic Safety, Bureau of Traffic Safety, State House, Trenton, N. J.

Conradt, Robert H.—Asst. Traffic & Safety Director, Traffic & Safety Section, New Mexico State Highway Dept.

Evans, Duaine T.—Senior Traffic Analyst, Louisiana Dept. of Highways, Baton Rouge, La.

Fielder, David G.—Nedrow, New York.

Galloway, William G.—Traffic Engineer, Kentucky Dept. of Highways, Traffic Division, Frankfort, Kentucky.

Grotterod, Arno J.—Civil Engineer, Public Roads Administration, Schwensensgt 6, Oslo, Norway.

Hartigan, Michael J.—Civil Engineer I, Bureau of Engineering, Dept. of Public Works, Rm. 1940, 20 North Wacker Drive, Chicago, Ill.

Hibbard, Walter, Jr.—Major, Office of the Chief of Transportation, Washington 25, D. C.

Hunnicutt, James M., Jr.—Traffic Engineer III, Bureau of Street Traffic, Chicago, Illinois.

Kanz, Anthony C.—Traffic Control

Engineer I, Bureau of Traffic Engineering and Electrical Service, City of Milwaukee, Wisc.

Leland, Elmer J.—Senior Aide Engineer, Traffic Division, State Highway Dept., Sixth and Spokane, Seattle, Wash.

Marlow, Joseph S.—Engineer I, Planning and Traffic Division, Michigan State Highway Dept., Lansing, Mich.

Nordqvist, Stig R.—Civil Engineer, A.B Vattenbyggnadsbyran, City Planning, Bureau of Consulting Engineers in Water Power, Water Supply & Sewerage, Box 5038, Stockholm, Sweden.

Ramos, Irineo Santos—Traffic Engineer, Bureau of Public Works, Manila, Philippines.

Reyes, Salvador F.—Instructor, Civil Engineering, University of the Philippines, Quezon City, Philippines.

Solomon, David—Highway Engineer, U. S. Dept. of Commerce, Bureau of Public Roads, Washington 25, D. C.

Villafane, Raphael Casanova—Civil Engineer, Puerto Nuevo, Puerto Rico.

Wardell, Edward J.—Asst. Highway Engineer, New Jersey State Highway Dept., Trenton, New Jersey.

you get LOW-COST,
ONE MAN OPERATION
with a JAWCO
LIGHTWEIGHT TRAFFIC LINER!
The JAWCO Lightweight Traffic Liner, with 5 gallon capacity, combines ease of operation with low initial, maintenance and upkeep costs.
One inexperienced man can easily give you smooth, even, straight traffic and zoning lines with a JAWCO Lightweight Traffic Liner.
Inquire today! For further information, delivery date and price, write —
WEAVER MACHINE COMPANY
P. O. BOX 1224 · PLANT OFFICE: 209-215 BUTLER ST. · YORK 1, PA.

WESTERN SECTION

BUFFALO BRIEFS

The Western Section delegation led by retiring ITE President Crandall (stage name—Bruce Campbell) was very much in evidence at the annual convention, particularly at the "Town Casino" where they made up almost the entire "bald headed row." Five will get you ten that a vote would show the most memorable feature of the '53 convention to be those two blondes in the hat making act. The lead act was Christine Jorgenson who described her operation—a very nip and tuck affair.

Hank Osborne and his commit tee did a wonderful job on arranging and were rewarded by a registration of 451 plus 90 on the distaff side—the biggest turnout so far! Seventeen Western-ITE's were there plus such celebrated exportees as Bob Schmidt, George Howie, Dave Dabney, Don Cleveland, Glen Johnson, Jim Booth, Hank Barnes, Hugh Wynn. It was the conclusion of the voting members present that all good Traffic Engineers start in the West and sink from there.

Kansas City contingent buys commercial time to plug 25th Annual. (L. to r.): George Fisher, Joe Feuchter, Tom Seburn and Leon Corder.

NEW YORK METROPOLITAN SECTION

The opening meeting (dinner) of the 1953-54 fiscal year was held at the President Tavern on September 17, with 32 members and guests present.

G. W. Treble, a guest from Buffalo, employed by the New York State Department of Highways, outlined the highlights of the coming Annual Meeting and expressed the hope that we would all attend.

Considerable discussion developed concerning the desirability of extending an invitation to hold the 1955 Annual Meeting in New York. It was finally decided to withhold this invitation.

(Continued on page 110)

Parking meters may be likened to participants in a marathon race. They all look good as they line up, and usually get off to a good start. But before the runners have gone very many miles, it doesn't take long to pick the winner.

So it is with parking meters. They all start well. Some play out quickly. Others last a few years. But it's the 5- to 10-year stretch that proves their worth. That's why we urge you to get actual proof of what you can expect from parking meters five or ten years after they have been installed.

It's not necessary to write off parking meters in five or even ten years. Many MI-CO installations, more than ten years old, are still giving new meter performance.

MI-CO Parking Meters are famous for long productive life, exceptionally low maintenance, and consistently high earnings. Whether you choose the MI-CO Manual or the original MI-CO Twin Automatic, you can't go wrong because both are built to give the kind of service you have a right to expect, and for many extra years.

Write for complete details together with performance records for both types of meters. Compare this data with records of other makes. We are sure you will agree that in the long run—down the 5- to 10-year stretch and beyond, MI-CO's have proved their superiority.

MICHAELS PRODUCTS:

Store Fronts
Lettering
Check Desks
Lamp Standards
Marquees
Tablets and Signs
Name Plates
Astragals
Railings
Grilles and Wickets
Kick and Push Plates
Push Bars
Thresholds
MI-CO Parking Meters
Museum Trophy Cases
Bronze and Aluminum Doors
Bank Screens and Partitions

MI-CO METERS, 241 Court St., Covington, Kentucky

Division of The Michaels Art Bronze Co., Inc.

New Appointments

Bruce Takes Over

John A. Bruce (Junior Mem., ITE) has been promoted to the position of Traffic Engineer for the City and County of Denver, Colorado. He replaces Mr. Henry Barnes (Mem., ITE). In his new capacity, he will be responsible for traffic planning and operations, signal engineering, maintenance, construction, street lighting, and several phases of safety education. Through the operation of this program, John's office must also maintain a close liaison with the State Highway Departments and the Planning and City Engineering Offices.

A native of Oakland, California, where he received his elementary and

John A. Bruce

public school education, he was graduated from high school in 1943. He entered the United States Army in April, 1944, went through infantry basic training and then joined the 76th Infantry Division and served with the Third Army in the European Theatre of Operations in a heavy mortar platoon. He was discharged from the Army in March, 1946, accompanied by three battle stars and the purple heart.

In 1946 he enrolled at the University of California at Berkeley, majoring in Civil Engineering under the transportation option; one of his undergraduate professors being Professor Don Berry (Mem., ITE) of the Institute of Transportation and Traffic Engineering. After being graduated from the University, he joined the staff of the Public Safety Department of the Automobile Club of Southern California as Traffic Engineer. With the Public Safety Department of the Auto Club he worked under the direction of Mr. Joseph Havenner (Mem., ITE), principally in the field of consulting with smaller communities regarding the solution of their traffic and parking problems.

In May, 1952, after two years with the Automobile Club, he accepted the position of Assistant Traffic Engineer for the City and County of Denver under Henry Barnes. In this capacity he worked primarily with traffic planning and operations. Much of this work being in close cooperation with the Department and the urban engineers of the State Highway Department in the Denver area. In July, 1953, John was promoted to his present job as Traffic Engineer.

A married man, without any children (yet), he is an avid sports enthusiast, a first-class bowler, and a model railroader. He is also a Junior Member of the ASCE and a member of the Colorado Society of Engineers and the Denver Chamber of Commerce.

Tuttle Joins A.S.F. Staff

Lawrence S. Tuttle (Assoc. Mem., ITE), an engineer with the United States Bureau of Public Roads for the past 25 years, has joined the engineering staff of the Automotive Safety Foundation. Mr. Tuttle has been assigned as Supervising Engineer of the West Virginia highway study, now getting underway.

Mr. Tuttle was graduated from Stanford University in 1928 with the degree of A.B. in Civil Engineering. He then joined the Division of Management of the Bureau of Public Roads, engaging in cost studies of highway construction in the Western States. He took a year's leave of absence from the Bureau in

Lawrence S. Tuttle

1929-30 to study traffic research and business administration at Harvard University.

Upon his return to the Bureau, Mr. Tuttle became a member of the Division of Highway Transport. In that Division, he played an important part in establishing the Highway Planning Surveys as a permanent feature of every State highway department.

In 1939, Mr. Tuttle became Assistant to the Commissioner of Public Roads. The work involved a great deal of time as liaison officer between the Bureau and the State highway departments, as well as with numerous other governmental agencies.

Mr. Tuttle also represented the Commissioner of Public Roads in a $14 million bridge project across the Mississippi River at Mamphis. This was completed and opened to traffic in December 1949.

From 1946, Mr. Tuttle was in charge of assistance to and training of engineers from other countries who came to the United States to study highway practice. This involved more than 1,000 visitors from some 60 countries.

The Department of Commerce Silver Medal for Meritorious Service was awarded Mr. Tuttle in February, 1952. He is a member of the American Association of State Highway Officials and the Institute of Traffic Engineers.

LOOKING AHEAD

JANUARY 5-7, 1954—ATLANTIC CITY, N. J.
Annual Meeting, American Road Builders' Association, Chalfonte-Haddon Hall.

JANUARY 12-15, 1954—WASHINGTON, D. C.
Annual Meeting, Highway Research Board, Academy of Science Building.

FEBRUARY 17-19, 1954—WASHINGTON, D. C.
White House Conference on Highway Safety.

MARCH 7-9, 1954—LOUISVILLE, KENTUCKY.
Southern Safety Conference and Exposition, Kentucky Hotel.

MAY 4-6, 1954—WASHINGTON, D. C.
Fifth Highway Transportation Congress Mayflower Hotel.

Position Available

CARACAS, VENEZUELA
TRAFFIC ENGINEER
CONSULTANT

Duties: To assist in National Traffic Planning. State qualifications. Tender of yearly contract dependent on three months' mutual trial period. Write directly to Dr. Tomas E. Reyna P., Inspectoria Nacional de Transito, Ministerio de Communicaciones, Parque Carabobo, Caracas, Venezuela.

Administration Report

Report of Committee on New Members

The Committee on New Members was officially activated on April 11, 1952, and directed to carry on an active and continuing campaign to attract into the Institute professional engineers *qualified* to become members of the Institute.

The Committee was further directed to activate a new Board policy of opening up membership in ITE to graduate engineers who work in fields closely allied to traffic engineering, such as city planners, geometric designers, transit engineers and consulting engineers who were qualified to become members.

The first few months of Committee activity were devoted to organization, selection of Local Section sponsors and the establishment of quotas for local sections and geographical areas. The "campaign" was officially launched at the Annual Business Meeting in Chicago a year ago. The membership was informed of the goal set by the Committee of increasing the membership to 1000 members. The total membership of the Institute at that time, including those elected by the Board the previous day, was 677 members.

Following the Annual Business Meeting, it was the concensus of opinion of the Committee that it would be impossible to expect an increase of approximately 300 new members in one year, so we set as our private goal a "50 per cent" achievement in the first year. Although we did not attain this goal, we established an all-time record for new candidates elected to membership in one year. We succeeded, with the full cooperation and support of the Local Section, the Membership Committee, the Board of Direction and individual members, in securing *103 new members* during the past year.

Some of the Local Sections were more active in the campaign than others and set excellent records for increase in membership in their areas. Following is a detailed accounting of achievement, indicating our Committee sponsor, the established quota and the degree of attainment of the "interim 50 per cent goal":

NEW MEMBERS
1952 - 1953 Institute Year

Section	Committee Sponsor	Quota	New Members	Achievement %
Canadian	M. M. Todd	10	4	40
Florida	P. L. Ristroph	10	4	40
Indiana	J. B. Neff	10	1	10
Michigan	S. J. Levine	30	9	30
Midwest	R. F. Gross	45	9	20
Missouri Valley	J. J. Feuchter	10	10	100
New England	R. M. Williston	30	14	47
New York	T. J. Fratar	40	17	43
Washington, D. C.	J. B. Ecker	40	10	25
Western	W. E. DeYoung	70	25	36
		295	103	39%

In addition to this remarkable record of achievement, I am pleased to announce that *all* Local Sections are now actively participating in the campaign and have established special Sub-Committees or Committees-of-the-whole to work with our sponsor. The newly activated Southern Section will replace the Florida Section for the coming year, and they will receive a new quota allotment.

I have already submitted to the Board of Direction a recommendation of reappointment of a selected list of candidates to continue to work with me during the coming year as your Committee on New Members. Our announced goal remains unchanged at 1000 new members. We hope to achieve this goal by the time of the next Annual Meeting in Kansas City. If the membership could band together in groups of 3 or 4 and each group obtain *one* new member during the next year, the success of our campaign is assured.

ROBERT S. HOLMES
Chairman

(Continued from page 107)

The speaker of the evening, Col. Arnold H. Vey, Director of the New Jersey Bureau of Traffic Safety, gave a very interesting talk on the "Historical and Organizational Setup of the Bureau of Traffic Safety." A short discussion period followed.

(The above report was inadvertently omitted from the November issue. We apologize for the delay.—EDITOR.)

The second meeting for the 1953-54 fiscal year of the New York Metropolitan Section was held at the Masonic Club at 12:00 noon on October 14. Twenty-one members and guests were present.

Our Section is joining with the Greater New York Safety Council in sponsoring the 24th Annual Safety Convention and Exposition to be held April 5-9, 1954, at the Hotel Statler. President Richard I. Strickland is our official representative in charge of the Convention. The traffic engineering theme will stress the accomplishments of the traffic engineer.

Interesting comments on the excellent Annual Meeting in Buffalo were made by Herb Klar, Ed Ricker and Ed Wetzel.

Mr. Frederick J. Eckhardt, Assistant Engineer of Traffic Council, New York City Department of Traffic, gave a short but interesting talk on channelization and some of the problems encountered by his office in connection with the installation and operation of channelized intersections.

Theodore T. McCrosky, Member, ITE, has opened his own Consulting Engineering office at 23 East 26th Street, New York, N. Y., for the practice of community and regional planning and development, traffic engineering, zoning, economic analyses and related work.

MID-WEST SECTION

SEEN AND HEARD AT BUFFALO

Over 30 members of the Midwest Section . . . Ralph Gross costarring with Christine Jorgenson at the Town Casino . . . Ross Wilcox trying to get Christine's room on the house phone. . . . Mister Michel . . . the Wiley family . . . Les Sorenson rearranging the table numbers at the banquet. . . .

R. Wayne Morris

It is with deep regret that we announce the sudden death of R. Wayne Morris (Associate Member ITE) Traffic Engineer of Phoenix, Arizona on December 7, following a brief illness.

Technical Division Activities

Use and Design of Portable Traffic Control Signals

Report of Technical Committee 3-F Reporting On "Is There a Place for Portable Traffic Signals" Technical Division, Institute of Traffic Engineers

The following report was approved by the Technical Council at their June 10th meeting. The Board of Direction reviewed and accepted Committee 3-F's report at their September 27th meeting.—EDITOR.

A number of manufacturers have developed portable traffic control signals and are offering them for sale. Very little practical experience has been developed in connection with use of such devices and this report should not be taken as an indication of approval of their use. However, the need is recognized for some qualitative guideposts for officials and others concerned with their possible use and the following information and recommendations are made for this purpose at the same time recognizing the lack of full and complete knowledge about practical application of these new devices.

Portability

It appears that these devices can be classified as portable within the meaning that they can be moved from one location to another. However, at least one manufacturer has incorporated several large storage batteries in the base of his unit which would make it most difficult to be handled by one person.

Another manufacturer provided for operation of his unit from the regular public service power supply, or, as an alternative, from a motor vehicle storage battery (using a 250-watt inverter). A consideration here would be the required use of a motor vehicle in connection with the signal.

There is, therefore, some question as to whether or not these are truly portable in the sense that they may be readily moved without difficulty.

Cost

Cost data are largely unknown. Representatives of one company with officers in various parts of the country have indicated their sales prices as ranging between five and eight hundred dollars, but apparently no final price has been set.

When it is considered that a single span wiire type signal with a six-circuit fixed time controller can be installed for six to eight hundred dollars as a temporary medium, it would be difficult to justify a cost such as mentioned above for a portable unit. Then, too, there may be added cost of manpower and equipment required to move the portable signals about.

Design of Signal Heads and Supports

These signals appear to be of conventional design, at least as to lens size, color, arrangement, and illumination. The height of some, if not all such signal heads, is below the standard height for permanent signals. The signal heads are not usually adjustable and this feature prevents proper facing. Whether or not this is a serious drawback, in view of the specialized nature of use of this equipment, is not known, and warrants further investigation. Similarly the matter of height deserves further study before positive recommendations are made, since there may be uses, such as in connection with pedestrian control exclusively, where standard height would not be mandatory.

Design of Controllers

One type of controller was investigated by a member of the committee and this led to the belief that continuous operation would not prove satisfactory because of the controller's extremely light construction. Therefore there is some question as to whether the controllers being used are of the proper design to be dependable.

At least one manufacturer has equipped his signal with a standard make of controller which can be acquired with either an induction or synchronous motor. With a synchronous motor, the signal could be coordinated with other installations, providing it was connected to a central power supply source. But connected to an isolated power source, such as an inverter-storage battery combination, coordination would be impossible because of frequency variations from the generator. The induction motor controller would be incapable of coordination regardless of power source.

Recommendation On Use of Portable Signals

Use of portable-type signals should be confined to emergency situations which would exclude use at school crossings or other locations regularly requiring traffic control. These devices could have a satisfactory use for emergency operation such as during breakdown of conventional type signals, or such as in connection with sudden and unpredictable needs in times of fire, floods or other disaster. Similarly they could be used for such special events as fairs, and sports events where large crowds of people have gathered, provided that such gathering is only of short duration and is not a regularly scheduled event such as horse racing which requires traffic control over a considerable period of time. They could be used on emergency detours around heavily traveled highways.

Recommendation On Design of Portable Signals

Portable traffic control signals should conform to the design standards set forth in the Manual of Uniform Traffic Control Devices insofar as signal heads are concerned, excluding height and adjustability. (Specifically, Sections 165 to 172, inclusive.)

Committee on Use and Design of Portable Traffic Control Signals

why ? ? ? ? ? ? ? ? ? ?

are so many parking lots metered with DUNCAN-MILLER

BRADENTOWN, FLORIDA lot equipped with 225 Duncan-MILLER 10-hour parking lot meters. Rate is 2-hours for 5c, adjusted to Nickels, Dimes, and Quarter.

● That's an easy one to answer, especially by those cities who've used Duncan-MILLER curb meters over the past 16 years. Financially speaking, these cities will tell you there's absolutely no question as to Duncan-MILLER'S revenue producing dependability. When parking is extended to off-street lots, the preferred choice is for the Duncan-MILLER meter as a never-failing source of funds for financing their lots.

● Building the same meter too, for over a decade and a half gives us the know-how to make a rugged "work-horse" type of unit, with more TIME and RATE combinations than any other parking lot meter, using NICKELS, DIMES, and QUARTERS.

Ask us for details.

DUNCAN PARKING METER CORP.

835 N. WOOD ST., CHICAGO 22, ILL. ● FACTORY at HARRISON, ARKANSAS

Manufacturers of AUTOMATON fully automatic and MILLER manual parking meter

Professional Service Directory

GANNETT FLEMING CORDDRY and CARPENTER, INC.
---ENGINEERS---
CONSULTING SERVICE FOR TRAFFIC, PARKING and TRANSPORTATION PROBLEMS
City Planning — Highways — Bridges — Flood Control
Water Supply — Sewerage — Industrial Waste — Garbage Disposal
Appraisals — Investigations — Management
600 NO. 2nd STREET HARRISBURG, PA.
Pittsburgh, Pa. Scranton, Pa. Daytona Beach, Fla. Medellin, Colombia, S. A.

EDWARDS, KELCEY and BECK
CONSULTING ENGINEERS
Surveys — Reports — Economic Studies — Design — Supervision
Transportation — Traffic — Parking — Terminals — Port and Harbor Works
Highways — Expressways — Grade Separations — Tunnels
Bridges — Water Supply — Management
3 William Street, Newark 2, N. J. • 250 Park Avenue, New York 17, N. Y.

PALMER AND BAKER, INC.
CONSULTING ENGINEERS — ARCHITECTS
NAVAL ARCHITECTS — MARINE ENGINEERS
Surveys — Reports — Design — Supervision — Consultation
Transportation and Traffic Problems Tunnels Bridges Highways Airports
Industrial Buildings Waterfront and Harbor Structures
Graving and Floating Dry Docks Vessels, Boats and Floating Equipment
Complete Soils, Materials and Chemical Laboratories
Mobile, Ala. New Orleans, La. Houston, Texas Washington, D. C.

RAMP BUILDINGS CORPORATION
PLANNING CONSULTANT
SINCE 1920
PARKING & AUTOMOTIVE SERVICE FACILITIES
MUNICIPAL PROGRAMS PRIVATE PROJECTS
Surveys — Reports — Design — Economics — Finance — Appraisals
230 Park Avenue :: New York 17, N. Y.

KNAPPEN — TIPPETTS ABBETT — McCARTHY
Engineers
Traffic, Parking and Transportation
Surveys, Economic Studies and Financial Reports
Highways, Subways, Bridges, Tunnels—Airports, Ports, Harbors, Power Developments, Water Supply, Sewerage
Planning, Reports, Design, Supervision of Construction
62 West 47th St. 110 Market St.
New York 36, N. Y. San Francisco 11, Cal.

Highway Traffic Engineers, Inc.
345 Boylston Street
Brookline 46, Massachusetts
LOngwood 6-0275

DE LEUW, CATHER & COMPANY
CONSULTING ENGINEERS
Transportation, Public Transit and Traffic Problems
Subways, Railroads, Industrial Plants
Power Plants, Grade Separations,
Expressways, Tunnels, Municipal Works
150 N. Wacker Drive, Chicago 6, Ill.
79 McAllister St., San Francisco 2, Cal.

JENKINS, MERCHANT & NANKIVIL
Consulting Engineers
Municipal Improvements Sewerage
Power Development Water Systems
Traffic Surveys Industrial Plants
Flood Control Recreational Facilities
Airports Investigations and Reports
805 East Miller Street
Springfield, Illinois

PARSONS, BRINCKERHOFF HALL & MACDONALD
Engineers
Bridges, Highways, Tunnels, Airports, Traffic and Transportation Reports, Subways, Harbor Works, Dams, Canals, Power Projects, Industrial Buildings, Housing, Sewerage and Water Supply.
51 Broadway New York 6, N. Y.

MATTHEW CAREY
MUNICIPAL FINANCE CONSULTANT
Specializing in Financing
Off Street Parking Facilities
Financial Advisor in Connection with Highland Park, Royal Oak, Wyandotte, Michigan and Kankakee, Illinois Automobile Parking System Revenue Bond Issues
Box 3703 Kercheval Station
Detroit 15, Michigan

AMMANN & WHITNEY
CONSULTING ENGINEERS
Design & Construction Supervision
Bridges, Buildings, Industrial Plants, Special Structures, Foundations, Airport Facilities, Expressways
76 Ninth Avenue, New York 11, N. Y.
724 E. Mason Street, Milwaukee 2, Wis.

Index to Advertisers

The revenue derived from the sale of advertising space assists the **Institute** in publishing TRAFFIC ENGINEERING on a regular monthly basis. The manufacturers listed below will be glad to cooperate with products and services which will be helpful to you in developing your traffic engineering and public improvement program.

A'G'A Division of Elastic Stop Nut Corp.	77	Minnesota Mining & Manufacturing Co.	90
Automatic Signal Division	102	Miro-Flex Company, Inc.	97
Crouse-Hinds Company	78	Portable Traffic Signals, Inc.	99
Dual Parking Meter Company	80	Prismo Safety Corporation	82
Duncan Parking Meter Corp.	112	Traffic & Street Sign Company	95
General Electric Company	Back Cover	Tuthill Spring Company	105
Grote Manufacturing Company, Inc.	96	U. S. Porcelain Enamel Co.	100
Karpark Corporation	104	Wald Industries, Inc.	Inside Front Cover
Mi-Co Meters	108	Weaver Machine Company	107

G-E TYPE V SEMI-VEHICLE-ACTUATED CONTROLLER

Moves traffic efficiently and safely at intersections

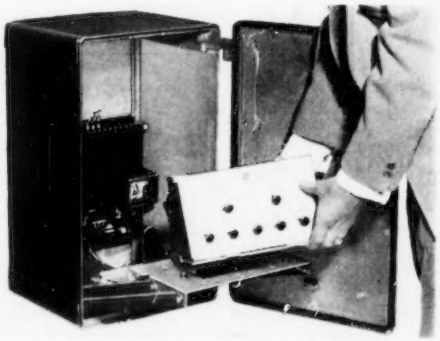
The G-E Type V semi-vehicle-actuated controller permits maximum flow on the main roadway (foreground), while traffic on the minor street (background) can cross through the intersection. Minimum delay is provided by the Type V controller because of its ability to count vehicles approaching the intersection. This exclusive feature, known as the traffic variable initial interval (rather than fixed), provides "green time" in accordance with the exact requirements of the vehicles detected. This gives minimum delay to main or arterial traffic. T-intersections such as entrances to hospitals, plants, and clubs are suggested applications.

SERVICING is easy with the same type of construction and maintenance features found in the famous Type F controller. The simplified electronic timing units and exclusive "service-minded" design features such as jack-mounted components make the efficient Type V popular with service crews.

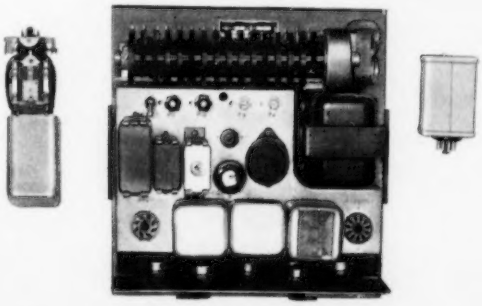
MORE INFORMATION is available from your nearest G-E Apparatus Sales Office or Traffic Control Distributor. G.E. also manufactures the Type V controller in a fully vehicle-actuated density model. For further details, write for Bulletin GEC-941, Section 453-61, General Electric Company, Schenectady 5, N. Y.

You can put your confidence in—

GENERAL ELECTRIC



TIMER IS EASILY REMOVED for shop servicing, and it swings out on pantograph arms for field inspection or maintenance.



JACK-MOUNTED RELAYS and unitized construction save service time and cost. All components are easy to see and replace.